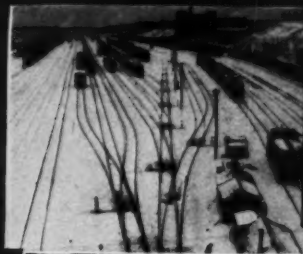


Railway Engineering Maintenance

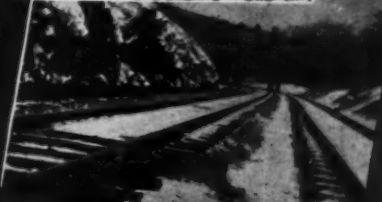
HECKS CURVE WEAR EVERYWHERE



- ★ Eliminates the danger of fire and sparks—no smoking.
- ★ Requires no welding—clamps to rail.
- ★ Readily removed to rails of heavier or lighter section.
- ★ Lubricates at low cost per mile of curve territory maintained.
- ★ Makes every component of track and train, using same lubricant all year around.



MECO CURVE-RAIL AND WHEEL-FLANGE LUBRICATOR



MAINTENANCE EQUIPMENT CO.
 Railway Exchange Bldg.
 CHICAGO

One of America's Famous Trains
BANNER BLUE LIMITED
 WABASH RAILWAY COMPANY

FOR 33 years the BANNER BLUE LIMITED of the Wabash Railway has maintained a dependable schedule between St. Louis and Chicago—today but a five-and-one-half hour run offering utmost comfort in its air-conditioned, all-steel cars. A smooth roadbed, carefully maintained, is always a factor in passenger comfort that eventually returns dividends in increased traffic, and the Wabash has a reputation for a high degree of comfort as well as for its reliability. In modern high speed main line traffic, rail joints protected by HY-CROME Spring Washers insure the greatest smoothness of riding qualities and economy of maintenance—two important features in the ever-growing competition for traffic.



Reliance HY-CROME Spring Washers

REACTIVE DEFLECTED
 Meets A. R. E. A. Spec.

THACKERAY
 For screw spike use

HY-REACTION
 For track bolts

STANDARD
 For general use

HEAVY DUTY
 For frogs—crossings

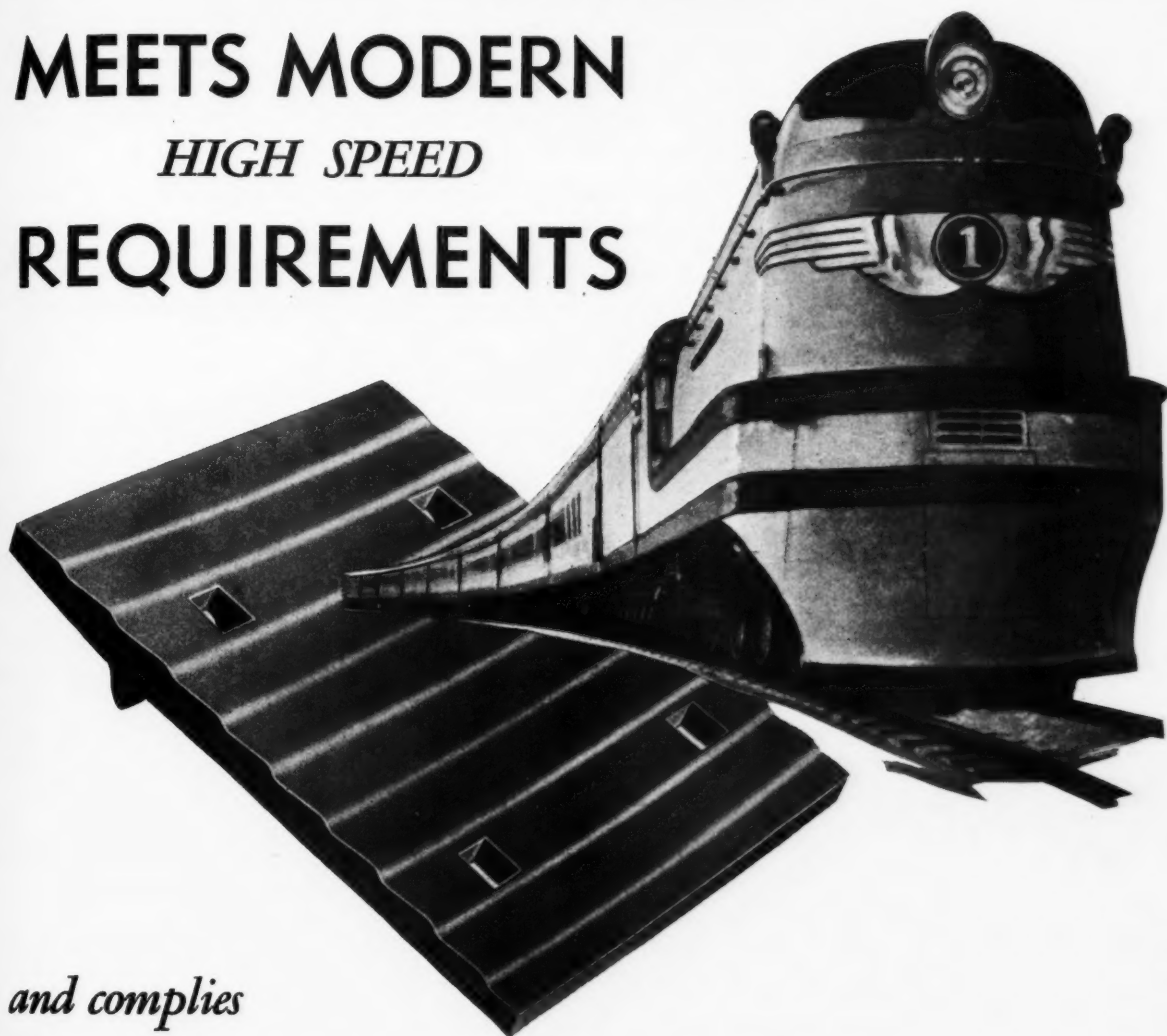
DOUBLE
 For special use

BONDING
 Used as tie



EATON MANUFACTURING CO. RELIANCE SPRING WASHER DIVISION, MASSILLON, OH.
 Sales Offices: New York • Cleveland • Detroit • Chicago • St. Louis • San Francisco • Montreal

MEETS MODERN *HIGH SPEED* REQUIREMENTS



and complies

with **A.R.E.A. STANDARDS** *in every respect*

THE Lundie is the safe and economical Tie Plate for modern high speed schedules. By reason of its scientifically designed bottom, the Lundie Plate not only prevents the spreading of track and holds gauge, but minimizes tie destruction and saves maintenance expense in regauging and surfacing. The Lundie Plate has no tie destroying projections and does not cut a

single tie fibre. It prevents slipping and relieves the thrust on the spikes. Lundie Plates are made with single or double shoulders to comply with A. R. E. A. specifications or can be furnished to meet your own specifications. Over 200,000,000 in service prove that Lundie Tie Plates reduce costs and improve track.

THE LUNDIE ENGINEERING CORPORATION

Tie Plates—Ardeo Rail and Flange Lubricator

19 West 50th St., New York

59 E. Van Buren St., Chicago

LUNDIE

TIE PLATE

Published monthly by Simmons-Boardman Publishing Company, 105 W. Adams St., Chicago, Ill. Subscription price, United States and Possessions, and Canada, \$2.00; Foreign \$2.00. Single copies 35 cents. Entered as second-class matter January 20, 1933, at the postoffice at Chicago, Illinois, under the act of March 3, 1879, with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

The NORDBERG POWER WRENCH

for regular maintenance
and rail laying



The swinging wrench arm easily gets to nuts at the inside and outside of the rail and at switches, crossings, etc.

Although announced but a few months ago, the new Nordberg Track Wrench has already won the approval of maintenance men. Its light weight, speed and low price makes it the outstanding wrench ever offered to railroads. Powered by an 8 horsepower engine and of extremely rugged construction, it is especially adapted to heavy duty tightening. Compact in design, it can be quickly removed from the track and set in the inter-track space, affording ample train clearance. An adjustable overload release assures uniform tightening. It will start any and all nuts or twist off bolts if nuts are frozen. Its speed makes it an especially valuable tool to have in the rail laying gang.

The Other Track Tools of the Nordberg Line

Adzing Machine	Rail Drill
Utility Grinder	Power Jack
Spike Puller	Rail Grinder
Track Shifter	

NORDBERG MFG. CO., MILWAUKEE, WIS.

NORDBERG MAINTENANCE MACHINERY

M

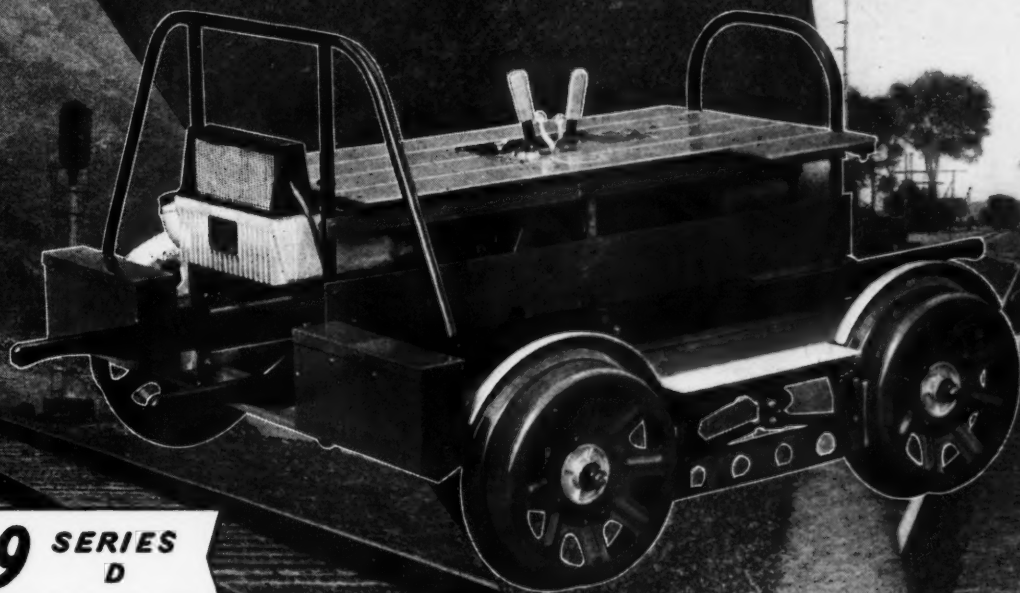
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With a
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New Stamina and New Power

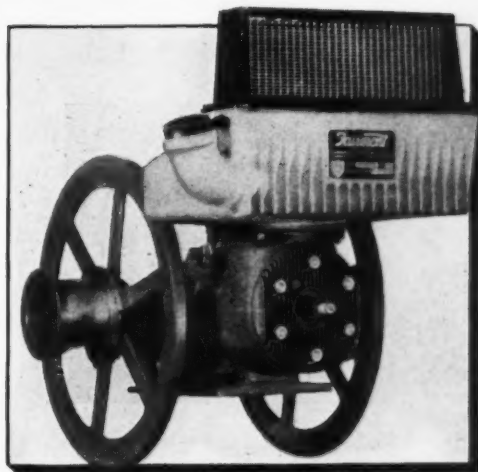


M19 SERIES
D

WITH ALUMINUM CONSTRUCTION

With a 14-year record of outstanding success, the Fairmont M19 brings another important improvement . . . new lightweight construction of aluminum alloy frame and 89 aluminum parts, reducing the lift of this one-to-four-man inspection car to 98 lbs. Fundamentally, it is the same car with free accessibility to all moving parts, with ample and convenient space for tools, and with spring mounting throughout to make it the smoothest riding car on the market today. With the new reduced weight, the Fairmont Model O Engine furnishes a surplus of power, even greater than before, for heavy loads and tough going. Railroad men will appreciate the value of the added stamina and added power now combined in the improved Fairmont M19.

Fairmont Railway Motors, Inc., Fairmont, Minnesota

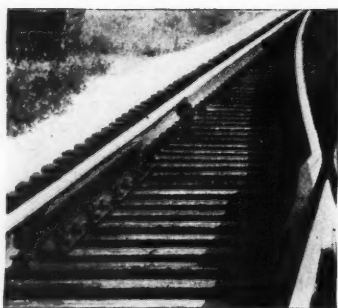
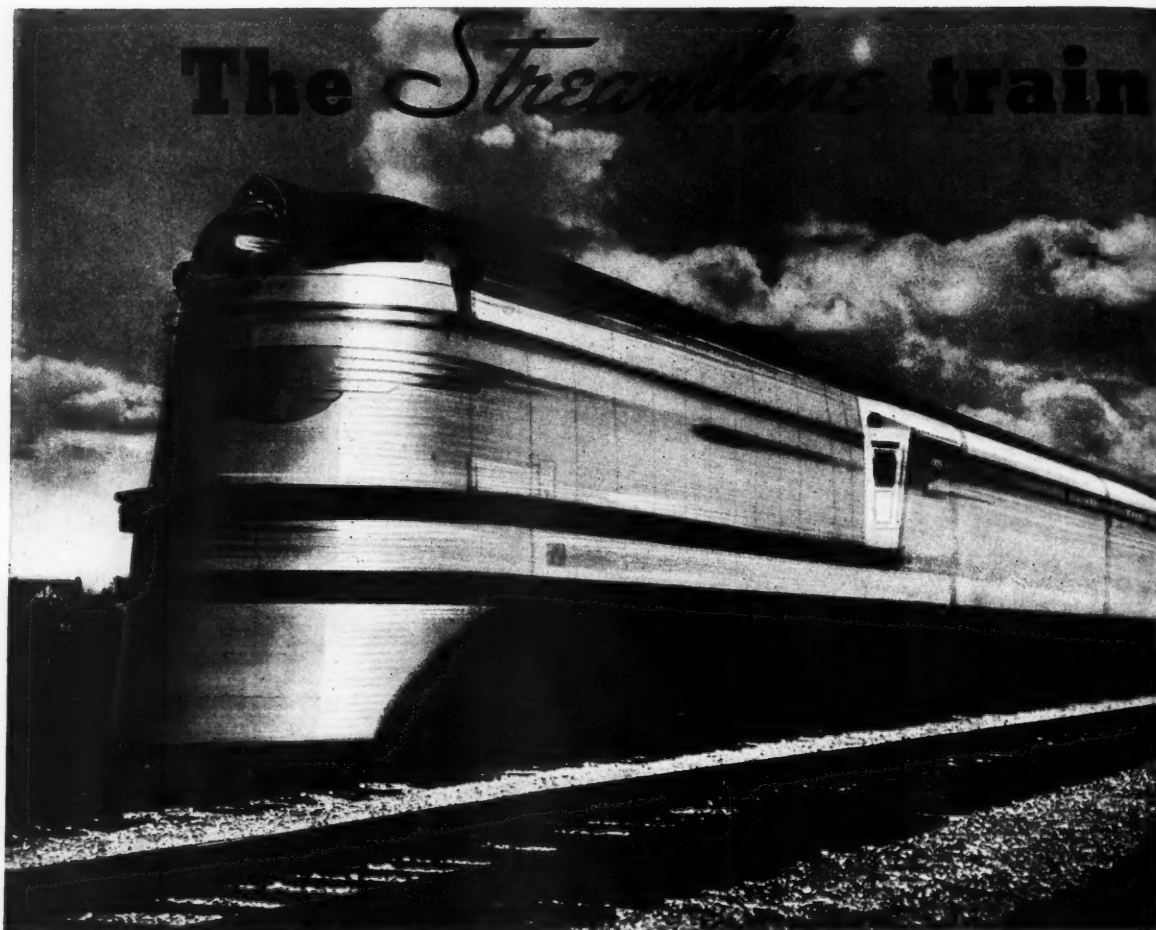


The Fairmont Model O Engine, noted for its surplus power, is of the same fundamental design that has been consistently improved through 14 years of continuous service.

**Performance
ON THE JOB
COUNTS**

Fairmont

Inspection Motor Cars . . . Section Motor Cars . . .
B & B and Extra Gang Cars . . . Gas-Electric Ditchers . . .
Shapers . . . Ballast Cleaners . . . Ballast Drainage Cars
. . . Mowers . . . Weed Burners . . . Extinguisher Cars . . .
Power Cars: Air, Electric, Paint Spray, Tie Tamping . . .
Rail Coaches . . . Motor Car Engines . . . Push Cars and
Trailers . . . Roller Axle Bearings . . . Wheels and Axles.



Safety and less damage to wheel flanges—Bethlehem Hook-Flange Guard Rail

The Bethlehem Hook-Flange Guard Rail is made of rolled steel. It combines high strength with resilience, to absorb and dissipate shocks.

This guard rail yields slightly when the flare is struck by the flange of a fast-rolling wheel. By this slight "giving" it cushions the impact and straightens the track without great shock, sparing both guard rail and wheel flange.

Because it is practically unbreakable, the Bethlehem Hook-Flange Guard Rail contributes materially to safe operation especially on high-speed track.



Resilience and adjustability at turnouts—The Bethlehem Spring Rail Brace

The Bethlehem Spring Rail Brace embodies two features of design fitting it especially for high-speed track—resilience that permits it to absorb the shock of vibration and recover fully, and adjustability that simplifies the work of holding track accurately to the requisite standards.

It consists of two parts, one of which is a combined rolled-steel switch plate and brace. The other is a wedge with spring incorporated. A pawl locks the wedge against loosening. The spring withstands a compression force of 12,000 lbs. before closing against the stop.



Makes both rails take the thrust—Bethlehem Gage Rod

The ruggedly constructed Bethlehem Gage Rod does much toward keeping track in the precise alignment so essential for the swift trains of today. It distributes the thrust at curves and turnouts over both rails, greatly reducing the stress on spikes.

The Bethlehem Gage Rod is a one-piece forging, hooked at one end, and threaded at the other to receive a clip which is held in position by a standard unit lock nut. For use at locations where there are track circuits it is furnished equipped with an improved, metal-protected, fibre insulating bushing.



a Question...

What about Track?

These Bethlehem products help to answer it

Today fleet greyhounds of the rails cruise at speeds that a few years ago were made only in occasional spurts under the most favorable conditions.

Bethlehem Track Accessories help to provide the greater precision of track structure required for this new tempo of rail-roading. They also have the added ruggedness to endure wear and tear that is intensified far more than proportionately to the increase in speeds. Write for literature giving more detailed information on these products.



Added safety for high-speed trains—Bethlehem Positive Signal Stand

The Bethlehem Positive Signal Stand provides the opportunity to raise safety standards to a new high level. It gives a positive continuous distant-signal report on conditions right at points—warning of any dangerous conditions, even when of such a nature that the target indicates clear.



Eliminates use of special tie plates—Bethlehem Twin Frog Plates

Bethlehem Twin Frog Plates fit any angle of frog and any weight of rail. They are made of rolled steel with a forged steel hook that is larger and heavier than a track spike—a hook that fits over the base flange of the frog and holds it down in position no matter how severe the service.



Dissipates wheel impacts—Bethlehem Heat-Treated Crossing

Increased speeds of freight trains multiply wear and tear on crossings. Bethlehem Heat-Treated Crossings oppose an almost invincible combination to the battering of heavily-laden wheels—extreme hardness and toughness plus the resilience of rolled steel.

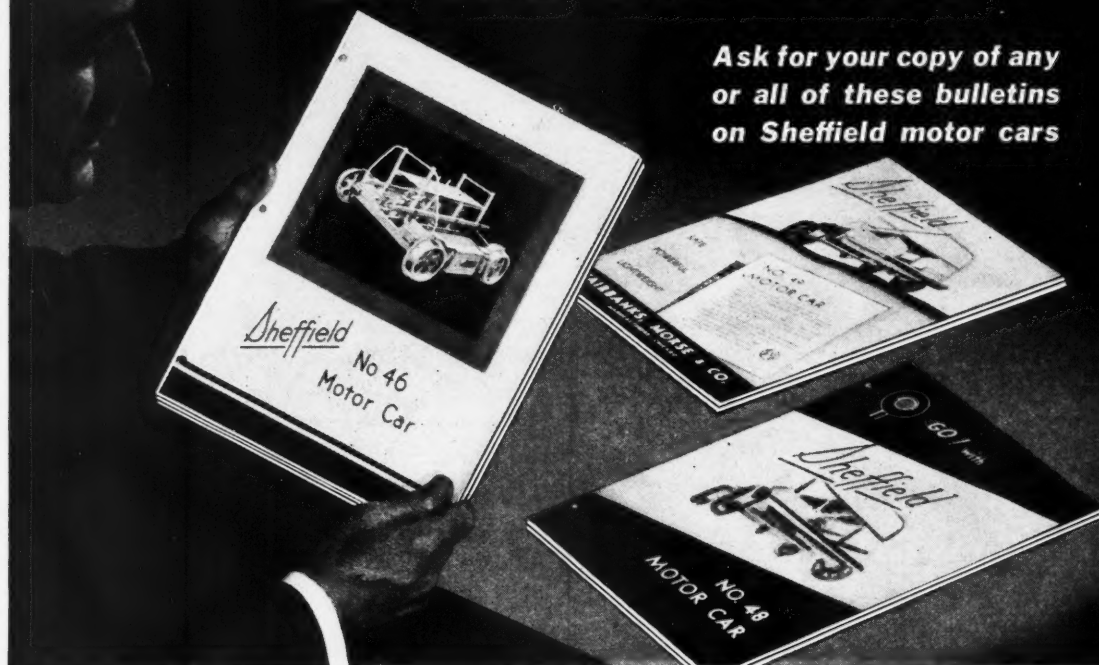
BETHLEHEM STEEL COMPANY



You may have seen them at the Railway Show... but

STUDY THE SPECIFICATIONS ON THE SHEFFIELDS

*Ask for your copy of any
or all of these bulletins
on Sheffield motor cars*



HAVE you kept up with the lighter weight of the new Sheffields? Their greater mileage per gallon? Their easier lift? Their improved safety features?

Then ask for your copy of one or all of our new booklets on Sheffield motor cars! The one-man car is the Sheffield

"46." The patrol, maintainer's, or light inspection car is the "48." The light weight section gang car is the "49." Just indicate which of these types most interests you. Address Department I-731, Fairbanks, Morse & Co., 900 S. Wabash Avenue, Chicago, Ill.

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YEARS OF
PRECISION
MANUFACTURING

FAIRBANKS - MORSE

Railway Equipment



POWER, PUMPING AND WEIGHING EQUIPMENT

TIMKEN BEARING EQUIPPED



Smooth-riding comfort at low cost
for **High Speed Trains**

AIRCOWELDED Rail Ends help many roads to achieve the smooth riding comfort for which they have become so noted. The Royal Blue, "crack special" of the Baltimore & Ohio R. R., pictured above, is an excellent example of a smooth-riding high speed train.

Airco Railroad Customers have reduced their maintenance costs to a minimum through the combination of Airco apparatus, oxygen and acetylene, and Engineering Assistance.

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SALES COMPANY**

General Offices: 60 East 42nd St., New York, N.Y.

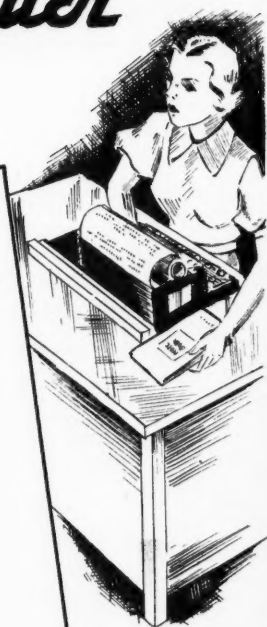
DISTRICT OFFICES and DISTRIBUTING POINTS in PRINCIPAL CITIES

A NATION-WIDE WELDING and CUTTING SUPPLY SERVICE



Miss Huber "Take a Letter" —

and Send It To These
Railroads



MORRISON
RAILWAY SUPPLY CORP.

WELDING AND GRINDING DEVICES AND SUPPLIES
OFFICES: BUFFALO - CHICAGO - PITTSBURGH - NEW YORK - ST. LOUIS - WASHINGTON - BRIDGEPORT

May 23, 1936

Gentlemen:

Back in 1930 we did some welding work for your road. Since that date you have become equipped to do your own welding with your own men...using the manganese welding method which is included today as a part of the Morrison Metalweld Process.

We welcome your use of our process...and hope that you continue to use it to your advantage. It is a process that we have developed through years of research and experiment and which we have patented because we believe it to be the only satisfactory method of welding manganese track units.

Since the time you adapted our process we have made many worthwhile improvements that add considerable to the efficiency of both men and equipment. We have perfected such essentials as the proper method of preparation and finishing. Today our process is more workable...and more economical than ever before. We sincerely believe that you will be interested in adapting these improvements to your present methods...and with this thought in mind we have devised, particularly for railroads such as yours, the MORRISON METALWELD SERVICE.

We invite you to subscribe to this service...and to obtain without charge the benefits of the knowledge which we have gathered through more than ten years of experience and concentrated effort in the field of manganese welding. Because of the widespread use of our process it is to our interest to see that those who use it may obtain the utmost in efficiency and economy.

May we have the pleasure of an inquiry from you for our booklet which describes in detail this MORRISON METALWELD SERVICE?

Yours very truly

Morrison Railway Supply Corp.

Raymond L. Hansen
Vice President

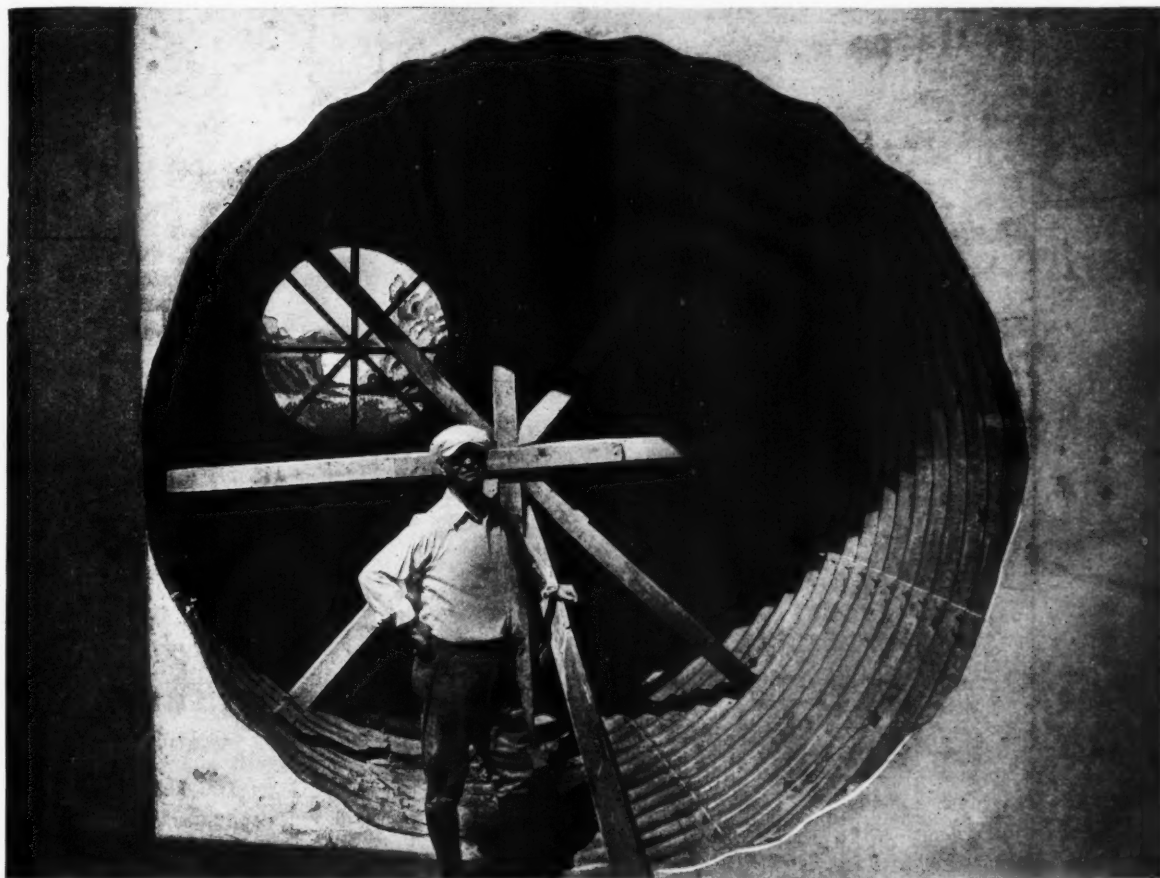
RLM:RH

P. S.

Our Subsidiary MORRISON METALWELD PROCESS INC. Is Equipped To Do Contract Work In Welded Repairs to Frogs, Crossings and Steel Bridges . . . and the Building-Up of Rail-Ends By Electric Arc or Oxy-Acetylene.

No Breakage

EITHER IN TRANSIT OR ERECTION



AND this means a lot to engineers and contractors who want no costly delays . . . particularly on time-contracts. The ease and speed of erection is another important economy factor.

Further, there is less excavation with *American Sectional Plate* construction, because of the smaller

wall section. There are no elaborate forms to build and remove, and shoring is rarely necessary. And so accurately are the plates formed that they literally "fall together" and any type of labor can easily and quickly assemble them, because of symmetric corrugations and uniform bolt holes. Only a few inexpensive

tools are required, and specially designed bolts help speed up all erection.

American Sectional Plates are prefabricated from Keystone Copper Steel, Pure Iron, or Copper-Iron plates, to meet the particular requirements of a given locality. Send for our interesting booklet on the subject.

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AMERICAN SHEET & TIN PLATE COMPANY • Pittsburgh

Columbia Steel Company, San Francisco, Pacific
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Export Distributors

UNITED STATES STEEL

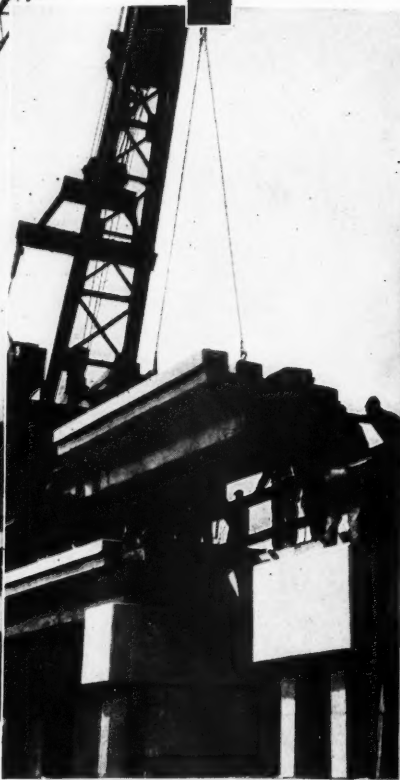
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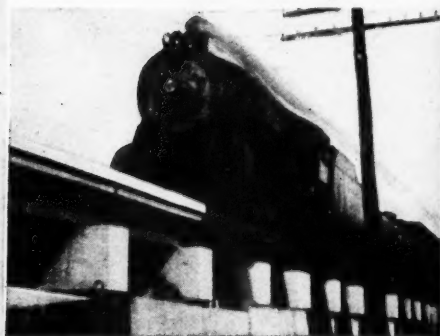
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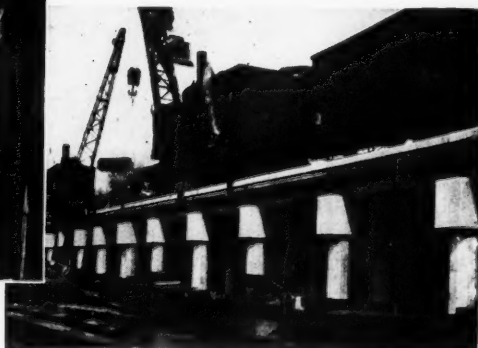
1 10:37 A. M. The small crane removes the old deck. Rails remain connected.



2 Big crane sets the 18-ft. half-slabs.



4 11:20 A. M. Only 43 minutes have elapsed from the time the removal of the deck began until track is blocked up on the slabs and the line is again ready for traffic.



3 Small crane is ready with track ties and blocks as the last slab is set.

using PRECAST CONCRETE TRESTLE DECK SLABS

TALK about ease and speed . . . it took only 43 minutes to remove two old deck panels, set two 18-ft. panels of concrete deck (4 precast half-slabs), and put track back in service.

Just normal operation to this crew, which has placed as many as 6 panels in 8 hours on this single-track line, with only 1½ hours maximum period of free time.

Much attention has been given to the fact that concrete trestles are fireproof, slow to depreciate and economical to maintain. To these familiar advantages add this one: concrete piles can be driven and deck slabs set with no more interference to traffic

—and perhaps less—than in building any other type of trestle.

As to *first* cost—a 3-pile concrete trestle, erected with proper equipment, crew and supervision, costs little more than less enduring construction. And where replacement must occur under adverse traffic conditions, concrete may easily be cheaper.

Write for Concrete Information Sheet RB-1, "Large Concrete Piles."

PORTLAND CEMENT ASSOCIATION
Dept. A6-27, 33 West Grand Avenue, Chicago, Illinois

Oxweld RAIL ENDS . .



*make Old Rail
ride like NEW . .*

• Building-up of battered rail ends by oxy-acetylene welding provides smooth riding rail to withstand increased speeds and heavier traffic.

Progressive methods for performing this operation have been developed by Oxweld Railroad Service. The rail ends on over 4000 miles of track were built-up under Oxweld Railroad Service supervision during 1935.

SURFACE AND CROSS GRINDING — speeds rail end welding programs and lowers the cost of this application.

Oxweld Railroad Service has been a factor in saving money for American railroads for almost a quarter of a century. This is confirmed by the continuous patronage of a majority of the Class I railroads during this time.



THE OXWELD RAILROAD SERVICE COMPANY

Unit of Union Carbide and Carbon Corporation

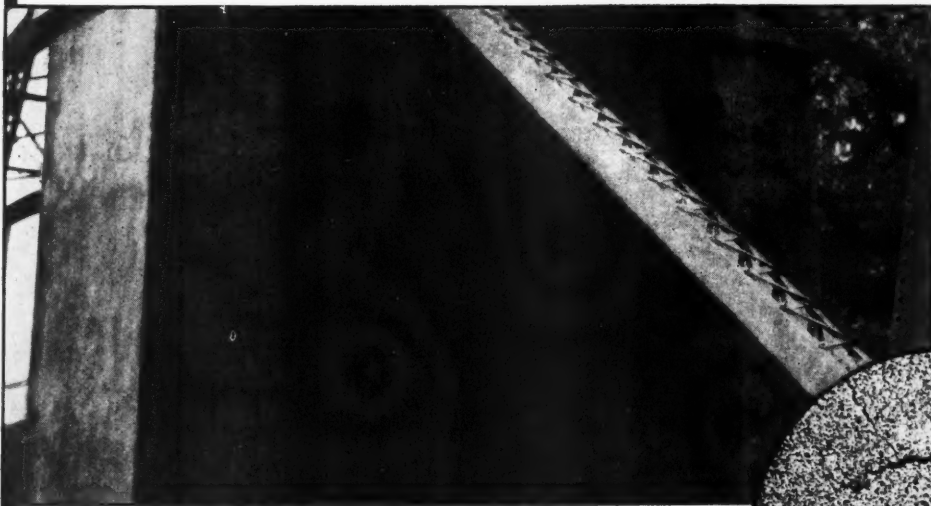
New York:
Carbide and Carbon Building



Chicago:
Carbide and Carbon Building

NON-SHRINK EMBECO

builds LONGER LIFE AND GREATER
DURABILITY *into* **GUNNED
MORTAR**



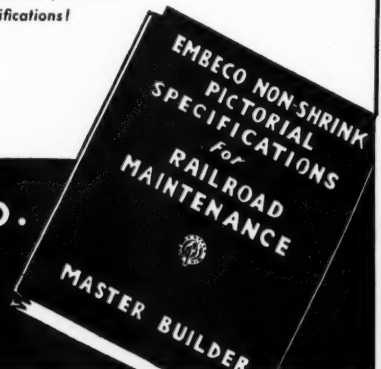
Pier of a railroad bridge after only several years exposure. (Repaired with ordinary gunned mortar)

Incipient shrinkage cracks (photomicrograph below) are the real cause of untimely disintegration. Moisture enters and failure begins!



• America's leading railroads are saving time, money, and trouble... with Embeco gunned mortars! Fast, economical and permanent, an Embeco gunned mortar job once done needs no re-doing! • Embeco is a specially prepared aggregate mixed with sand and cement to produce a NON-SHRINKING, perfect-bonding mortar highly resistant to attack by weathering. Ordinary mortars become crazed with small, often invisible shrinkage cracks during the process of setting. These cracks, permitting moisture to enter, become larger under the disruptive force of freezing and thawing, actually inviting disintegration. Embeco builds into gunned mortar a density never before attainable... a durability long desired by engineers throughout the nation!

... Write now for this interesting, factual book of Embeco pictorial specifications!

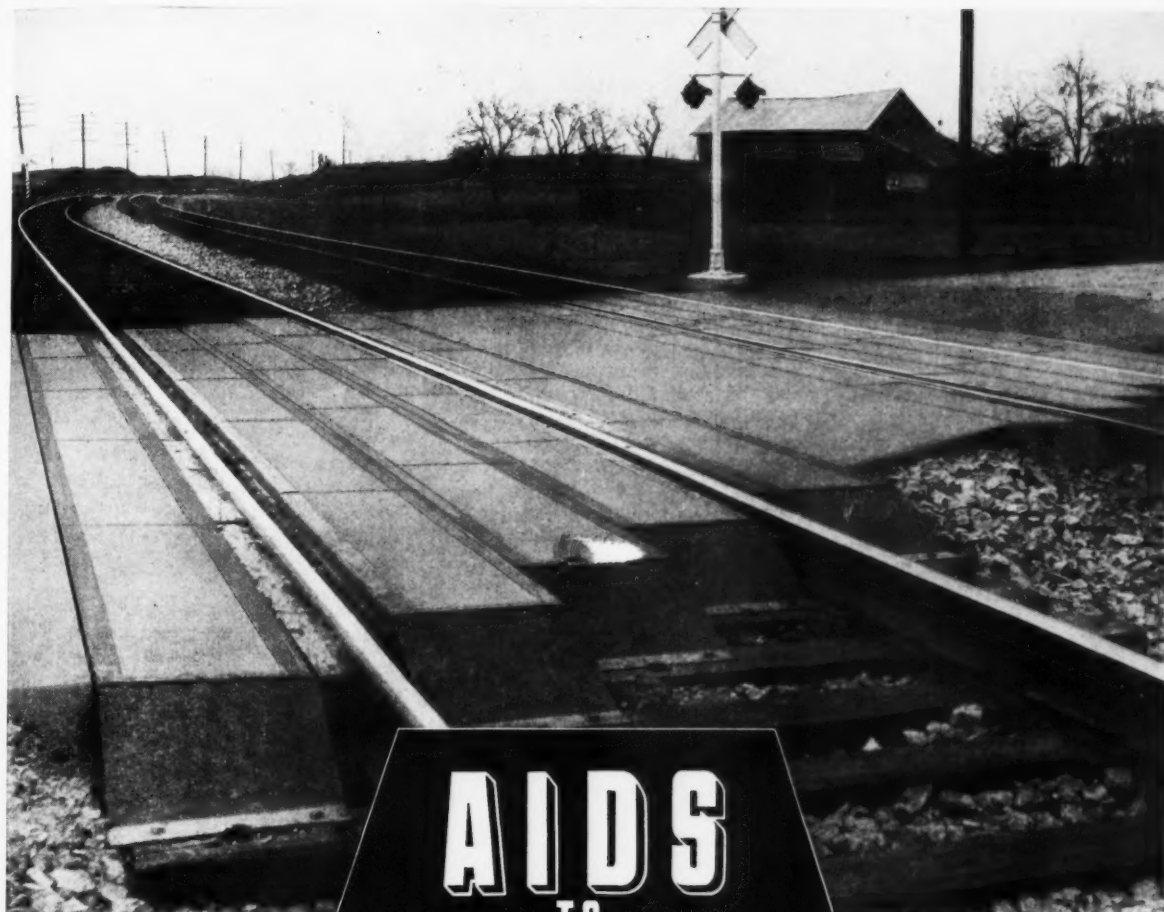


THE MASTER BUILDERS CO.

CLEVELAND,
OHIO



TORONTO,
ONTARIO



Truscon Weltrus Highway Crossing units are copper alloy steel forms filled with concrete. They are interchangeable and can be removed easily for track maintenance work.

AIDS TO RAILROAD PROGRESS

Truscon Intertracks Slabs between double tracks function the same as the smaller sections between the rails. Truscon intertracks sections armor and reinforce concrete.

TRUSCON WELTRUS HIGHWAY CROSSINGS

The public's widespread interest in grade crossing elimination presents a serious problem for all railroads. Improvement in railroad earnings are threatened if excessive costs of grade crossing elimination projects eat too rapidly into profits. On the other hand, public good will must be maintained.

This problem is often solved by the use of Truscon Weltrus Highway Crossings which reduce maintenance costs and minimize highway crossing

accidents and their resultant claims. Likewise, they are relatively inexpensive to install and provide the safety, permanence, smoothness and non-skid advantages demanded by the public.

Add up all the advantages of Truscon Weltrus Highway Crossings and it is easy to see WHY they are AIDS TO RAILROAD PROGRESS! The cooperation of Truscon engineers is available without the slightest obligation on your part. Complete information will be furnished promptly.

TRUSCON STEEL COMPANY

YOUNGSTOWN . . . OHIO

No. 90 of a series

Railway Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: AN AID TO PROMOTION

May 28, 1936

Dear Reader:

I received a letter a few days ago which interested me greatly by reason of the contrast which it drew between two types of men. I believe that it will be of equal interest to you, coming as it did from the chief maintenance officer of one of our largest railways. I quote from this letter as follows:

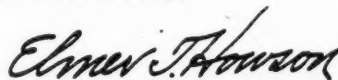
"In your letter of April 30 to the readers of the May issue of Railway Engineering and Maintenance, you stated that the first issue of the Maintenance of Way section of the Railway Age was dated May 19, 1911. I was appointed a roadmaster in May, 1911. I have had the privilege of reading every issue of the Maintenance of Way section of the Railway Age and its successor, Railway Engineering and Maintenance, and I have found every issue interesting. Some issues, of course, were more interesting than others, as they contained articles that dealt with conditions on our railroad or with problems that we were attempting to solve. Other articles were interesting because they brought new information and ideas and in that way helped me to keep up with developments beyond my immediate field.

"Probably I might not have been such a long and faithful reader if it had not been for the position taken by the management of our railroad in subscribing for your publication in behalf of its maintenance officers of the rank of roadmaster, bridge supervisor and above. During the later years when I have been privileged to have some voice in such policies, remembering how interesting the publication always was to me and the help that it brought, I have always been strongly in favor of continuing the policy of the company carrying a liberal subscription list. I know that our maintenance officers appreciate this action very much, for they are keenly interested in the matters presented and derive a great deal of benefit from the issues as they come out."

This officer is typical of that group of men who are attracted to railway service as a career—alert, eager for new ideas, preparing for advancement. In no other industry do officers come more largely from the ranks than in railway service. Nowhere is the opportunity for promotion greater—if one is prepared to grasp the opportunity when it comes.

During the last 25 years, I have received many evidences of the help that Railway Engineering and Maintenance has been to men in bringing to their attention new ideas and new practices that have aided them in improving their performance and thereby placed them in line for promotion. Have you ever thought of your magazine in this light?

Yours sincerely,



Editor

ETH*JC

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.



COMPLETE Tie Tamping Outfit CARRIED!

Unless you already know the Barco Unit Tytamber the idea of one man picking up complete equipment and *walking down the rails with it* sounds ridiculous.

It was the Barco which brought the track maintenance department this new idea of portability. It immediately began saving both time and money while accomplishing splendid results with all types of operation—large gangs or singly. Around terminals where train movements are heavy or on the main line.

The Barco Unit Tytamber is entirely a one-man tool. Every section gang should be equipped in order to maintain track at low cost. Make sure your road knows how low costs really can be—with a Barco.

BARCO MANUFACTURING COMPANY
1805 W. Winnemac Ave., Chicago, Ill.

In Canada — The Holden Co., Ltd.
Montreal — Moncton — Toronto — Winnipeg — Vancouver

UNIT TYTAMPER



Left: The body of King Tut-Ankamen, preserved in asphalt, has withstood decay for 3000 years.—(Courtesy World Wide Photos). Right: As you can see from this photomicrograph, the bituminous material is actually "bonded" to the pipe, by means of asbestos fibres which are embedded in the galvanized coating.

CORROSIVE CONDITIONS won't harm This Improved Corrugated Iron Drain

o Engineers have long realized the value of bituminous coatings, as a means of protecting metal surfaces against severe *corrosive* conditions. Pure bitumen, you know, is impervious to moisture and it resists more acids and alkalis than almost any other substance. Remember, too, that the smooth, thick *pavement* in the bottom of Armco Paved Invert Pipe is a special grade of pure bitumen—proved by 10 years of drainage service.

Now . . . Armco engineers have discovered a way to "bond" a complete bituminous *coating* to the pipe in such a manner that it *will stick indefinitely*. This new process, known as Asbestos Bonding, also widens the plastic range of the bituminous material— as much as 50 per cent.

No wonder *Asbestos Bonded* Armco

Paved Invert Pipe appeals so strongly to railway engineers. Besides being permanently sealed against corrosive influences, this pure Ingot Iron pipe offers many other advantages that simply cannot be obtained with heavy, rigid materials.

Just get in touch with our nearest office and they will gladly send you complete data describing this special railroad drain.

★ ★ ★

INGOT IRON RAILWAY PRODUCTS CO.,
Middletown, Ohio, Berkeley, California, (Member of the Armco Culvert Mfrs. Assn.); Philadelphia, St. Louis, Salt Lake City, Los Angeles, Minneapolis, Houston, Portland, Atlanta, Denver, Chicago, Dallas, El Paso, Spokane, Cleveland, Pueblo, Sidney, Richmond.



ASBESTOS BONDED Armco Paved Invert Pipe

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

 June, 1936



Published on the first day of each
month by the

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Editorials - - - - -	349
Our Country—Fusion Welding—Uncoupling Rail—Correct Gage—Shanty Towns	
Mile-Long Rails Installed - - - - -	352
The Bessemer & Lake Erie has butt-welded rails by the Thermit process in a stretch of experimental track near River Valley, Pa.	
Weatherproof Scale-Pit Decks - - - - -	356
In spite of a severe climate the Canadian Pacific has had no trouble from water or ice in scale pits that are not provided with drainage	
Maintaining Turnouts - - - - -	357
O. L. Spyres offers some valuable suggestions on the upkeep of frogs, switches, and other parts to insure adequate safety of operation	
Lowering a Tunnel Under Traffic - - - - -	358
How the Pennsylvania solved a severe reconstruction problem in the face of extraordinary difficulties	
Stabilizing Gumbo Roadbed - - - - -	362
E. E. Barton draws on his own experience in describing methods of dealing with insecure track resulting from soft roadbed	
A Novel Cure for Water Pockets - - - - -	363
Driving of cull ties along each side of the track has proved so effective that special equipment has been designed for this work	
Grouted Base for Tracks in Streets - - - - -	365
Description of method employed by the Baltimore & Ohio that can readily be applied by a small gang of unskilled laborers	
When an Abutment Tips - - - - -	366
A. R. Ketterson outlines the procedure to be followed in dealing with this troublesome problem effectively and safely	
How Many Ties? - - - - -	368
Julius H. Parmelee and Graham E. Getty discuss tie requirements at the annual convention of the Railway Tie Association	
What's the Answer - - - - -	369
Products of the Manufacturers - - - - -	376
What Our Readers Think - - - - -	377
New Books - - - - -	377
News of the Month - - - - -	378

ELMER T. HOWSON
Editor

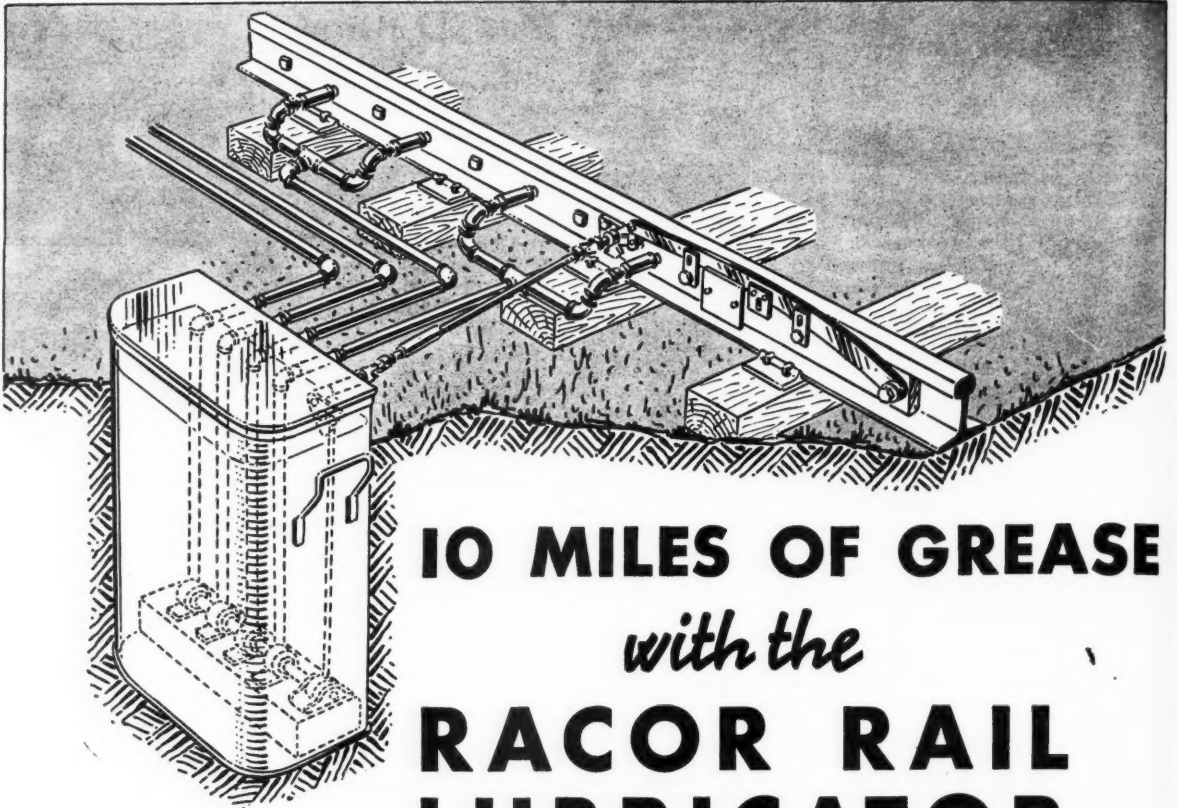
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Four gear pumps, actuated by a ramp, deliver the lubricant through eight grease pipes to the chamber between the delivery plate and the rail, shown in section X-X.

Distributors on the delivery plate deflect the lubricant so that it is forced out of the delivery slot in a continu-

ous line. The grease is thus picked up by the side of the flange in such a manner that the flange retains the maximum amount of lubricant on the surface coming in contact with the high rail of a curve and a minimum amount is wasted.

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Railway Engineering and Maintenance



Our Country

The Future of its Railroads

WHAT is the future of the railroads? Is a basic economic change occurring in our national life that will relegate them to the background? Or are they, in common with our country and its basic industries, going through a period of readjustment that will bring them all to new high levels of activity and prosperity?

Before considering the railways alone, it may be well to look at a few facts relating to the present status of our country as a whole.

Some Records

(1) In its relatively short history, our country, with only seven per cent of the population of the world, has produced half of the wealth of the world.

(2) Although including only six per cent of the area of the world, our country raises more than half of the world's food supplies,—and consumes most of that produced.

(3) Our country owns and operates 40 per cent of the world's mileage of railways; it owns and uses half of the world's communication facilities.

(4) The people of our country own and operate more than two-thirds of the automobiles of the world.

(5) Our country mines 60 per cent of the world's minerals.

(6) Our country produces and consumes half of the world's output of electricity.

(7) With only seven per cent of the world's population, we consume half of the world's supply of coffee, tin and rubber; one-fourth of the world's supply of sugar; three-fourths of all the silk produced in the world; one-third of all the coal mined; and two-thirds of the oil.

(8) Our country has a total purchasing power greater than that of all the countries of Europe combined.

(9) Our country spends four billion dollars annually for education, more than all the rest of the world.

(10) Our people have in force more than 115 million life insurance policies with a face value of more than 100 billion dollars—70

per cent of the life insurance in force in the world.

(11) Our country includes more than 3,500,000 farms operated by as many owners, more than 60 per cent of which farms are unencumbered. More than 14 million families own their homes, 55 per cent of which are without mortgage or lien of any kind.

(12) The privileges of our country are so widely recognized that more than 50,000,000 aliens have migrated here during the last 50 years and so many more want to come that we have been forced to erect formidable immigration barriers.

(13) And we have experienced 34 depressions since the United States became a nation. We have recovered from all of them except the present one and we are now on the way out of it.

With a background such as this, our country should continue to be an area of great development for generations—with opportunities for tapping resources as yet unthought of. And such a country, with its vast distances, requires an adequate system of transportation as its first essential—a system that will transport vast quantities of food stuffs, minerals and raw and finished products of manufacture with dispatch and economy.

Place of the Railroads

This is a service for which the railways—and the railways alone—are fitted. Other agencies, in the air, on the highways and on the waterways, can carry limited quantities of traffic in limited areas and under certain favorable conditions, but the main responsibility for bearing the nation's burdens day in and day out must rest ultimately on the rails.

It is true that there are problems to be solved—problems of adaptation of railway service to the newer and more flexible needs of industry—problems of regulation to afford equality of competition between all agencies of transportation—problems of co-ordination to restrict each agency to that sphere to which it is best adapted and to develop to the maximum its service in that sphere, etc. But who would say that a nation and a people that within the short period of this country's existence can show the progress that has already been made do not have the ability and intelligence necessary to solve these problems? This is the answer—the challenge—of the railways to their critics.



New Lines

Will Give Less Trouble in Maintenance

THE mileage of new railway lines to be built in the future will be far less than in the past, but maintenance officers may derive considerable comfort on one score—those that are built will be turned over to them in better shape than has been the case with most lines constructed heretofore. There are two reasons for this, both of which mark the trend of the times.

One of them is to be found in the objective which has been responsible for the limited amount of construction now in progress and will be the incentive for more extended construction in the future, namely, the improvement of lines for faster schedules. Unless relocations to eliminate heavy curvature or grades that interfere with higher speeds are built to a standard that permits of the contemplated speeds immediately after completion, the objective will have been largely lost; hence the inclusion in grading specifications of stipulations that will insure solidification of the roadbeds as they are being formed.

The other reason is to be found in the availability of grading equipment with which embankments may be readily constructed to meet the most drastic requirements for solidification at little, if any, greater cost than that of forming fills by the old dumping-from-trestles process. The modern crawler or wheel-mounted wagons, drawn by tractors, and large capacity motor trucks are especially adapted to the forming of fills in layers, but with far greater compacting effect than was the case in the days of the animal-drawn wagons, slips and wheel scrapers. Extraordinary maintenance should be a negligible factor on new lines built at present or in the future.

Fusion Welding

Rapidly Emerging from the Experimental Stage

FUSION welding, as applied to the fabrication of structural steel, had its beginning about the time of the World War. Applied at the start to the construction of small steel frame buildings, it was not employed on bridges until 1927, when wide interest was aroused by the use of the electric-arc process in the strengthening of the Chicago Great Western bridge across the Missouri river at Leavenworth, Kan. From that time, development in this field was rapid. Within a year a 62-ft. plate girder span and a 135-ft. through truss span for railroad loading were completely fabricated by fusion welding.

Although constructed for promotional purposes, these latter two bridges did not give rise to any enthusiasm for the application of the process in the design and construction of new bridges. There was, however, a widespread movement toward the application of fusion welding in the repair and strengthening of old bridges. The economy and convenience of the process were quickly recognized and railway bridge engineers were constantly developing new means of applying it.

As in all pioneer work, the development had to pro-

ceed without the benefit of established standards to govern either design or construction technic. Mistakes were made, questions were raised; and no little experimental work has been done to develop means of avoiding the pitfalls and to furnish answers for points at issue.

Out of this practice and study, carried on under various auspices, there was gradually accumulated a fund of knowledge from which it was possible to compile a set of rules of good practice. This task was assigned in 1934 to a committee organized by the American Welding Society, with the co-operation of other engineering associations. Its work has now taken tangible form as a book of specifications that has just been issued, thus providing for the first time a common guide for the control of all phases of fusion welding as applied to structural work. Thus, after some 20 years of development, the process has "grown up." No one contends that the last word has been said; the new specifications will be subject to change as more complete data are revealed, but they provide the foundation on which the work can proceed in a more orderly manner than in the past, and the groundwork for further development. The recent completion of two more new all-welded railroad bridge spans is evidence that further progress may be expected.

Uncoupling Rail

Should It Be Before or After Removal?

PRACTICE with respect to the uncoupling of released rail varies widely, and considerable difference of opinion exists as to the way it should be done. Some roads throw the old rail out in almost continuous strings, except where it must be broken at crossings, turnouts, etc., and uncouple it later. Others break every joint and bar the rails out individually, while still others bar it out in strings of 10 to 20 rails. Again, a few roads break every joint and lift the rails out singly with a crane.

In former years, when rail was light, a few men with bars could throw out long strings with relatively little effort and no particular hazard. This was probably as economical as any other method, since all operations were performed by hand anyway. This practice has been continued in certain quarters, despite the fact that rail has increased in weight and stiffness to the extent that more men are required and considerable hazard is involved in barring out long strings. Furthermore, double-shoulder tie plates, where used, add to the difficulty of barring the rail out in strings, additional men being needed and additional hazard being introduced.

Another change in conditions results from the fact that power wrenches are now available for unbolting the rail while it is still in the track, one or at most two machines being sufficient to keep ahead of the main operation. These machines eliminate the necessity for assigning 10 to 12, and sometimes more, men from the gang for the nut-stripping operation, as was formerly necessary when the rail was uncoupled in the track. Some types of these power wrenches cannot be used to run the nuts off after the rail is thrown out, while it is often difficult for other machines to reach them. Again, it is not always possible to keep the rail upright as it is being

barred out, in which case only half of the nuts can be reached until the rail is turned over, consuming additional time and labor.

Modern practice demands that maintenance operations be completed as they progress. This requires that released rail and scrap be loaded day by day in conformity with the progress of the rail gang. If the stripping of the joints is allowed to follow the laying of the rail there is always some interference with the loading operations which may fall behind and result in more track being occupied than will be necessary if the stripping is done in the track ahead of the gang.

In view of the fact that power wrenches are available for stripping the joints in the track, and that this can be done economically without interfering with the work of any other unit, at the same time substantially eliminating the hazard incident to the removal of the old rail, it appears that this method possesses advantage. The exception is a small gang that is laying a short stretch of new rail without power tools, when all operations will be performed by hand and there may be no economy in stripping the joints in the track.

Correct Gage

High Speed Increases Its Importance

THE introduction of so-called superspeed passenger trains and the increasing number of shortened schedules have stimulated exceptional interest in problems of alignment, rate of curvature, spiral approaches and super-elevation on curves. This is as it should be for there are few roads on which curvature does not form the principal obstacle to uniformly high speed. If the alignment of a curve is not true or the elevation is insufficient or irregular, a serious hazard to high-speed operation may be created.

Likewise, much has been said, but in more general terms, about the necessity for a higher degree of excellence in track maintenance on tangents. It is conceded that the more nearly track approaches perfection the better it will ride. But what constitutes perfection? In general, the answer is a true line and a smooth surface. Back of these, however, as every experienced trackman knows, is a multitude of details which must be given the closest attention, without which neither line nor surface can be maintained to the desired standard. Not the least of these is gage.

As train speeds are increased, substantially all of the destructive forces which act on the track are increased far out of proportion to the increase in speed, particularly if line, surface and gage are not kept near perfection. In this connection, Robert Faries, assistant chief engineer-maintenance of the Pennsylvania, stated in a paper which he presented recently before the Western Railway Club at Chicago, that at high speed, "the maximum lateral forces exerted on good track were about 7,000 lb., but when the track had been roughened artificially to the extent that regular trains would have been limited to 50 miles an hour, lateral forces as high as 35,000 lb. were recorded with the same equipment and speed of trains."

If the gage is wide or irregular, the amplitude and violence of the lateral movements of car and locomotive wheels are increased as the speed increases, and the wheel flanges strike, with a distinct shock to both equipment and track, first one rail and then the other.

Careful investigation has shown that it is not necessary for the gage to be grossly incorrect to produce this result, for only a minor increase in width or irregularity is sufficient to do so. Trackmen have always known that good line and surface cannot reasonably be maintained where the gage is faulty. The present trend toward higher speeds is emphasizing this interrelation between gage, line and surface. At the same time, the maintenance of correct gage is becoming of greater importance as a necessity for reducing the stresses in track.

Shanty Towns

Dispose of the Surplus Buildings

THE railroads are the owners of thousands of buildings designed for a multitude of purposes. The construction of stations and the more important structures at engine terminals, as well as the larger shop buildings, has been brought about as the result of rather systematic planning, but many small auxiliary houses and sheds have been brought into existence in a haphazard manner, like the additions to the farmer's house following successive visits of the stork. Thus, every terminal and many station grounds have been cluttered up with small frame buildings—many of them converted box car bodies—that have produced what have aptly been termed "shanty towns."

In many cases these structures were erected to serve temporary needs that have long since disappeared; in fact, there was a surplus of these structures before the advent of the depression. With the decline in business the need for many of these buildings has further decreased, and owing to pronounced changes in organization and practice a large part of them will never again be required regardless of increases in the volume of traffic.

Constructed with a view to minimum first cost, most of these auxiliary buildings are expensive to maintain per cubic foot of contents, and during the long period of retrenchment they have suffered serious neglect. Most of those no longer used have received no attention whatever, but these structures impose no particular problem because most of them will eventually be wrecked, salvaging whatever usable material they contain.

The real problem concerns the buildings still in use, namely, the switch shanties, tool houses, coal sheds, bunk houses, and a multitude of others that, like Topsy, "just grewed." Some of them comprise fire hazards, others are ill-suited for the function they serve, most of them are of a character that does not make for easy maintenance and nearly all are unsightly. The situation would appear to offer opportunity for a thorough investigation, looking toward the elimination of unnecessary structures and the consolidation of the occupancy of many others in new buildings of a slightly and substantial character, requiring less maintenance.



On the Mile-Long Section of Test Track on the B. & L. E. Comprising GEO Construction With Continuous Butt-Welded Rails

Mile-Long Rails

Installed in GEO Test Track

WITH the intention of making a comprehensive investigation of the performance of GEO track when the rails are welded into continuous lengths, the Bessemer and Lake Erie has installed an experimental section of such track, a mile long, in the southward track of its double-track main line near River Valley, Pa. In this installation, in which the rails were butt-welded by the Thermit process into continuous lengths for the entire distance, it is planned, by means of permanent monuments and strain-gage readings, to record longi-

tudinal and lateral movements of the rail and to determine the extent of the stresses that are induced by variations in temperature.

Provisions for Tests

Unusually complete provisions that have been made for observing the performance of the rail in this test track include the installation of permanent monuments at the ends of the sections and at three intermediate points. At each end six sets of these monuments were installed, including

one at the end of the welded rails, four sets at 50-ft. intervals and the sixth 100 ft. beyond the fifth. The three intermediate monuments were located at the mid-points of two curves and a stretch of tangent. At each of these locations a monument, on which was centered a punch mark, was installed on each side of the track, and, using a transit, a punch mark was made on each rail in line with the marks on the two monuments. The temperature was recorded at the time each set of monuments was installed and is also to be record-

ed whenever any work or measurements involving the use of the monuments is carried out. Longitudinal movements of the rail are to be determined by noting the distance that the punch marks on the rail have moved north or south of the line between the punch marks on the monuments, while lateral movements will be determined by noting changes in the distances between the punch marks on the rails and the monuments.

To obtain data for computing the stresses set up in the rails as the result of temperature changes, provision has been made for the taking of Berry strain-gage readings. These readings will be taken at 50-ft. intervals for 500 ft. from each end of the section and at intervals of 500 ft. throughout the remainder of the test track.

For making the Berry strain-gage readings, two small holes, 7.85 in. apart, have been drilled into the web of the rail at each point where readings are to be taken. In boring these holes a templet was used for guiding the drill, which was clamped over the head of the rail. The drills used had a 3/64 in. point, 1/16 in. long, which widened out to 3/32 in.; thus the diameter of each hole decreased from the surface down. The Berry strain gage, which is equipped with prongs that fit into these holes, is capable of measuring

the distance between the holes to 0.0001 in. Readings with the strain gage were taken before the rails were welded, after they were welded, and after the track was given the final surfacing, and will be taken from time to time in the future.

This experimental track is in the southbound main just north of River Valley. Of this mile of track, 3,320

In an experimental track which it has installed near River Valley, Pa., the Bessemer and Lake Erie has butt-welded both rails by the Thermit process. By means of permanent monuments and strain-gage readings it plans to observe longitudinal and lateral movements of the rail and the magnitude of the stresses set up by temperature changes

ft. is on curves, including from south to north 1,998.5 ft. of a 1 deg. 30 min. curve and a three-center compound curve, 1,321.5 ft. long, which embraces 5-deg., 3-deg. 20-min. and 5-deg. 43-min. curves. The three intermediate permanent monuments are located at the mid-points of the two curves and the tangent which separates them. Both ends of the section are on tangents. It includes two 1,200-

ft. vertical curves, one in a sag and the other on a summit, which are connected by 811 ft. of 0.65 per cent grade descending with traffic. For a considerable distance at the south end, the track is on a level grade.

The traffic handled over this track consists almost entirely of heavy through freight trains having maximum wheel loads of 37,905 lbs. and operating at a maximum speed of 35 miles per hour. The tonnage moving over this territory in normal times amounts to from 10,000,000 to 12,000,000 gross tons annually. No high-speed passenger trains are handled.

New Track Installed

In making the test installation a complete new track structure above the subgrade was installed. The new structure comprises 12 in. of sub-ballast, 9 in. of crushed limestone ballast below the bottoms of the ties, 7-in. by 9-in. by 8-ft. 6-in. red oak treated ties, GEO tie plates and fastenings, and 131-lb. R.E. rail in 39-ft. lengths. The ties were pre-adzed and bored and were treated with an 80-20 creosote-petroleum mixture, 6 lbs. of which was injected per cubic foot of wood.

During the placing of the new track structure and the welding of the rails, which was done on the ground, the line in this vicinity was converted to single-track operation, the north-

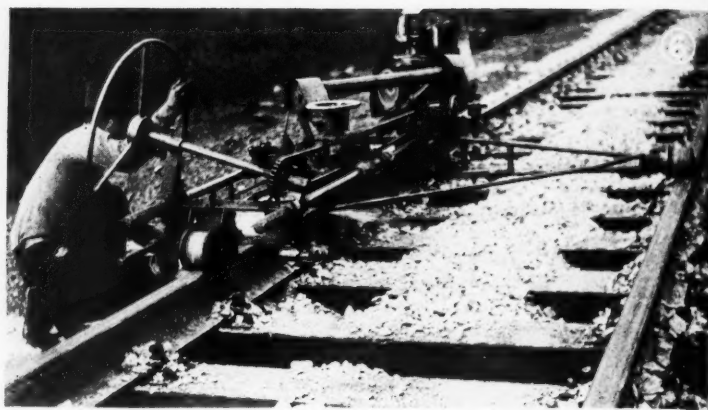


1. Removing Rust and Scale From the Rail Ends. 2. Removing Metal From the Base and Lower Half of the Web of a Rail End With an Oxy-Acetylene Torch.



3. Adjusting the Clamps. 4. Applying the Mold. Note the Preheating Equipment at the Left.





bound main being used for movements in both directions. After the old track had been removed, a spreader operating on the northbound track reduced the old ballast to the subgrade elevation. The new ties, to which the GEO tie plates had been attached previously, were then distributed, the majority being stacked in piles along the right-of-way. The remainder, amounting to about 25 per cent of the total, were placed on the subgrade where they served as a support for the rails during the welding operations. To prevent the tie plates from interfering with or hampering the handling of the rails, these ties were turned on their sides. The rail was then distributed and arranged on the ties in position for welding.

The welding of the rails was carried out under an arrangement with the Metal & Thermit Corporation, which company supplied all equipment and materials necessary for making the welds and doing the grinding, and also furnished representatives who exercised supervision over, and had actual charge of all phases of the welding and grinding operations. Fuel for the rail preheaters and grinders, the necessary oxy-acetylene cutting equipment and all labor were furnished by the railroad.

Welding Procedure

The Thermit method of butt-welding rails, as applied on the B. & L. E., involving a pressure weld of the heads and upper portion of the webs of the two rails and a Thermit fusion weld of the bases and the lower part of the webs, comprised no marked deviation from recent practice in the making of such welds. The ends of each rail were undercut or beveled at the mill to a depth of $1/32$ in. at the base, and an additional $1/4$ in. of the base and the lower half of the web of each rail end were removed in the field by oxy-acetylene cutting torches. The head and the upper por-

tion of the web of each rail were then faced at the ends with hand files to remove the scale and rust.

The joints were prepared and welded in groups of four. As the first step in this process the rails were carefully lined and the clamps for forcing the rail ends together in obtaining the pressure weld were applied. The molds, consisting of a mixture of sand, clay and gluten, contained in metal flasks, were prepared on a push car which followed immediately behind the welding operations. After the mold had been applied to the rail ends, being held in place by clamps and thumb screws, the molds as well as the rail ends were preheated by directing a jet of flame, consisting of a burning mixture of air and kerosene vapor, through a heating gate in the mold. The air and kerosene vapor mixture was provided by a compressed air preheater equipped with an electrical resistance coil for vaporizing the kerosene before it was mixed with the compressed air, which was furnished by a gasoline-engine driven Victor-Acme rotary pump. The mixture was conveyed to each mold through a rubber hose, each of two preheating units being used to heat two joints simultaneously. This preheating raised the temperature of the

rail ends to about 1,600 deg. F. and required about 44 min. for each joint.

While the preheating of the rail ends was in progress the crucible was attached to the clamps at each joint and charged with the Thermit mixture. When the preheating had been completed the nuts on the clamps holding the rails together were given $1/8$ turn to counteract the expansion due to the preheating, after which the Thermit mixture was ignited and, on the completion of the reaction, the molten metal and slag were allowed to flow into the mold around the rail ends. Three minutes after the tapping of the crucible, the nuts on the clamp bolts were given $1/4$ turns, thus producing a movement of about $3/16$ in. and causing the rails to be forced together under high pressure. About ten minutes after each weld was made the flask was removed, the mold and slag adhering to the rail were knocked off and the weld in the head of the rails was pounded with a sledge to reduce any lip that may have been formed and to restore the grain structure. An average of 17 and a maximum of 24 joints were welded per day.

The grinding of the welds was carried out in two principal steps, including first a rough grinding and second

8. The Reciprocating Grinder in Operation. 9. Restoring the Contour of the Rail Head With a Hand File. 10. Planing the Sides of the Rail Head by Hand.





5. Preparing the Thermit Mixture While the Rail Ends are Being Preheated. 6. A Rotary Grinder in Operation. 7. How a Portable Grinder was Used to Grind the Sides of the Heads of the Rails

a finish grinding. In the first step the upsets at the welds that were formed as a result of the pressure exerted by the clamps were ground down only sufficiently to permit the passage of ballast cars. In this step the top surfaces of the rails were ground by a Fox Hi-Speed rotary grinder, while an electrically-driven hand machine was used to grind off the metal on the sides of the rail heads. The finish grinding, which was done with a Railway Track-Work Company reciprocating grinder, was not done until after the remainder of the ties had been inserted, the ballast spread and the track lined. The final rounding of the corners of the rail heads was done by hand, both a hand grinder and files being used for this purpose.

Track Work

Following as closely as possible after the welding gang, a track-laying crew placed the balance of the ties in the track and applied GEO shims and clips, although the latter were not tightened until later. After the rough grinding of the welds had been completed the ballast was applied and the track raised and given a final line and surface. The clip bolts were then tightened, the temperature during this

operation ranging from 60 to 70 deg. F. No difficulty was encountered in lining and surfacing the track.

The organization employed on the welding and grinding work included an assistant engineer who was in direct charge of the work; 2 laborers preparing the ends of the rails; 2 lin-

by the Metal & Thermit Corporation, each of whom devoted his attention to a certain phase of the work. The track-laying and surfacing work was carried out by a track gang of 30 men.

The sequence of operations on this project and the date of starting or completing each one were as follows:

Removal of old track and preparation of subgrade commenced on October 7, 1935

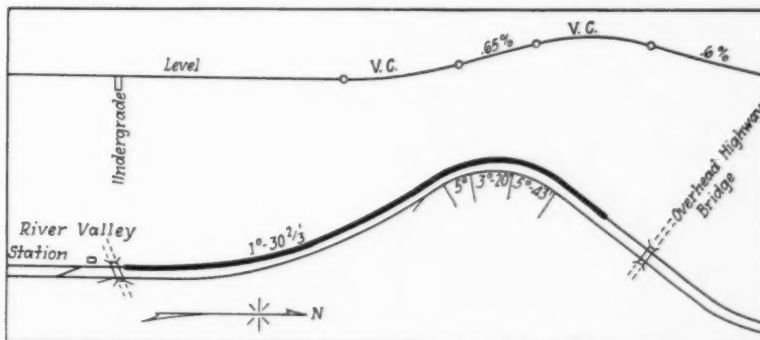
Distribution of ties and rail commenced on October 9

Welding started on October 10 and completed on October 29

Grinding of welds completed on November 8

New track completed on November 9.

Including one joint that was welded for test purposes, a total of 269 joints were welded on this project. Of these only two were defective because of improper workmanship, the failure to obtain good welds being in each case due to the fact that the thimble in the bottom of the crucible was misplaced



Plan and Profile of the Experimental Section. The Heavy Line Indicates the Test Track

ing the rails and placing the clamps in position; 2 preparing the molds; 2 applying the molds; 2 preheating the rail ends and pouring the metal; 2 removing the molds; and 2 or 3 grinding the joints. The organization also included three supervisors furnished

when the tapping pin was driven up to tap the crucible. As a result the molten metal and slag flowed out of the crucible so rapidly that it overflowed and did not fill the mold, resulting in an incomplete fusion weld. These joints were cut out with oxy-acetylene



torches and rewelded. Certain minor defects in several other welds were repaired by oxy-acetylene welding.

The composition by analysis of the metal in the fusion portion of the welds made in this project, together with that of the metal in the rails, is given below:

	Thermit Metal	Rail
Carbon	.407	.73
Manganese	.74	.75
Phosphorus	.036	.027
Sulphur	.058	.034
Silicon	.44	.15

Observations of this section of welded rail have indicated that the maximum longitudinal movement has been 11/32 in. at the north end and 14/32 in. at the south end. At the south end, for example, the maximum movement is made up of a minus movement (contraction) of 8/32 in. and a plus movement (expansion) of

6/32 in., making a total of 14/32 in. with a maximum variation from the monumented line of 8/32 in. The temperatures that were recorded when these measurements were taken varied from 5 deg. to 77 deg. F., while the lowest recorded temperature during the winter was -20 deg. F.

Practically no lateral movement of the rails has taken place. Small differences, the maximum of which was 1/8 in., were noted during the first month at three of the monuments, but no further differences have been noted except one of 1/8 in. at the north end.

All work in connection with the installation of this test track was carried out under the general supervision of H. H. Harman, engineer of track, and F. R. Layng, chief engineer, of the B. & L. E., to whom we are indebted for the information that has been presented in this article.

a dry pit. The primary features of the design that was developed are, therefore, a pit having walls sufficiently impervious to resist the inflow or seepage of ground water and a weatherproof deck which prevents the entrance of surface water, either in the form of rain, sleet, melting snow or drippings from cars.

Lead Rail Eliminated

In addition to the original provisions for insuring a dry pit, it was decided recently to eliminate the dead rail. In part, this was done to reduce the first cost of the scale installation without increasing the cost of maintenance or shortening the life of the scale. Although rules were in force requiring the use of the dead rail for all movements not directly connected with weighing, many cases were found where they were being ignored and the dead rail was not in use. The abandonment of the dead rail was simplified by the fact that, where practicable, scales are located on tracks that are used for weighing only, not for switching operations.

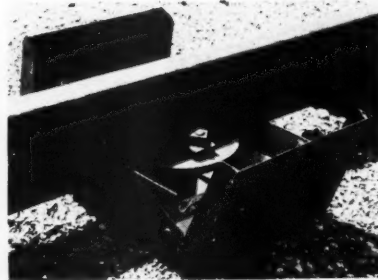
To compensate for the additional wear that was likely to occur through a complete abandonment of the dead-rail construction, it was decided to use a heavier scale mechanism. It seemed preferable to put some of the difference in the cost in the mechanism rather than to continue the dead rail, the advantages of which were doubtful. Further-

Canadian Pacific Builds Weatherproof Scale-Pit Decks

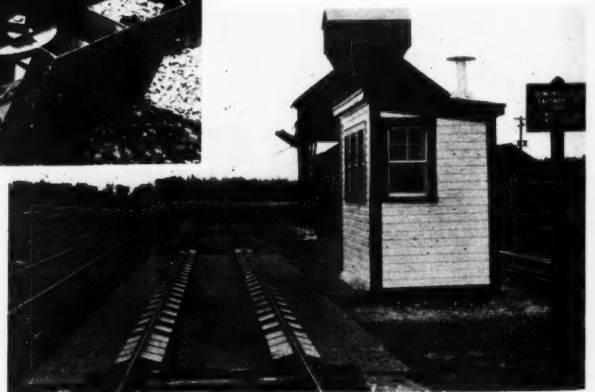
FOR several years the Canadian Pacific has been installing track scales in which no provision is made for pit drainage. Yet, even in the severe climate of the territory through which this road is located, no trouble has been experienced with water or with ice accumulations around the scale members. In fact, the scale members are kept so thoroughly dry that maintenance has been greatly reduced and weighing has been consistently more accurate than formerly.

Since the first scale pit of this type was constructed about 13 years ago, the design has been subject to a process of gradual improvement and simplification, until in its present stage it has been adopted as standard by the road. One of the features of the plan is that there are no dead rails, all improvements across the scale being made over the live rails.

Formerly, much trouble was experienced from freezing during the severe winter weather which characterizes this territory. Even with the best provisions for drainage, pits were often wet and soggy and it was not uncommon for scales to be put out of commission by accumulations of frost and ice. Scale maintainers



Above—A Hood Open for Inspection.
Right—The Latest Scale Installed



were constantly working overtime in an effort to keep the scales in operating condition. In addition, there was marked deterioration from corrosion. As a result of these conditions, light weighing was all too common.

For these reasons, an intensive study of track-scale pit and deck construction was undertaken with the view of developing a design that would insure a waterproof deck and

more, it was found that the elimination of the dead rail simplified the problem of providing a weatherproof deck.

An important feature of the design of the deck is the fact that it is entirely independent of the rails or their supports. It consists of a self-supporting covering of mill construction, of 2-in. plank, either 4, 5 or 6 in. wide, depending on the span, laid on edge and nailed together to

form a solid laminated floor laid transversely of the track to span between the sides of the pit, but extending to the outer face of the pit walls. Since the wall plates are always of the same cross-sectional dimensions as the deck planks, only one size of lumber is required.

If the track grade is not sufficient to provide for the desired run-off, the deck can be given a transverse pitch, since it is independent of the rails. Weatherproofing is accomplished by applying ordinary tar, or asphalt, and gravel roofing, using ample gravel to insure a walking surface that will protect the roofing felt.

In developing the design, special attention was directed to minimizing obstructions which might interfere with a quick run-off of any water that falls on the deck. This has been accomplished by supporting the rails, well above the deck, on specially designed pedestals which, in turn, rest on the weigh bridge. These pedestals pass through holes in the deck, which have ample clearance, not only to prevent interference with their movement as the rail is loaded or unloaded, but to permit their removal and replacement.

Special care is exercised to prevent the entrance of water into the

pit through these openings. To this end, before the roofing is applied, they are flashed with suitable sheet metal which projects about 4 in. above the deck. When the roofing is applied, it is brought well around the flashing and sealed. The rail stands are then protected by metal hoods which are secured to the rail and fit over the flashing, but with sufficient clearance to insure that there will be no contact between them and any part of the deck structure. They are provided with hinged covers which can be swung back, as shown in the illustration, to permit inspection of the pedestals.

About 25 scales with pits and decks of this design are now in service on the Canadian Pacific, a few of them for as long as 10 years. In some cases, extremely difficult problems would have arisen if it had been necessary to construct an outfall sewer for the purpose of draining the pits. In all cases the scales, pits and clearances conform to the recommended standards of the American Railway Engineering Association, the only special features connected with these installations being the deck construction. The foregoing description is based on information supplied by J. W. Orrock, engineer of buildings.

a worn stock rail. To get the best service out of the point, the stock rail should be changed out when the point is renewed. There are instances where the stock rail can be turned around and thus give a full ball for points to work against. Loose guard-rail bolts, and sometimes the absence of bolts, leaving the guard-rail without support, are responsible for accidents at frogs.

Too much or uneven elevation between the heel of the frog and the tangent on the turnout behind the frog are generally the cause of, or at least contribute to, most derailments on the turnout behind the frog. Turnouts, unless they are on the inside of a curve, do not have any elevation, at least from the point of switch to about 15 ft. behind the heel of frog, and if the elevation is abrupt or too great between this point and tangent, it puts engine or cars in a twist, and if they happen to be rigid, it will cause the wheels to lift over the top of the rail.

Clip bolts, guard-rail bolts and frog bolts should be kept in place and tight. In fact, if provision has been made for a bolt in any part of the switch, frog, rail joint, or any other part of the track structure, the bolt should be there.

Switches, frogs and guard rails should be kept well oiled. This retards corrosion, makes them work more easily and prolongs the life of the material.

Turnout rails between the heel of the switch point and the frog should be watched closely. I have known them to get high enough above the main-line rails to foul the low underhanging parts of engines and cars. This condition arises in most cases because the main line rail has settled in the ties more than turnout rails. This condition can best be corrected by turning the switch ties over to get a uniform bearing on the ties for both tracks.

Another important part of a switch, which should not be overlooked in making a switch inspection, is the safety cap on the main rods. Sometimes they become corroded and weakened to the extent that a light tap or jar will cause them to fall off, leaving a connecting rod without any protection and the vibration of trains over them will cause them to rise up and become disconnected from the main rod.

All switches should be thrown often enough to enable the foreman to know that the points fit up properly to both tracks. Those who throw switches should leave their motor cars on the opposite side of the points from the direction in which they are going, to make sure that the switch has been left properly lined.

Maintaining Turnouts*

By O. L. Spyres

Roadmaster, Kansas City Southern
DeQuincy, La.

A TURNOUT is the weakest part of the track and a considerable proportion of the total derailments occur at turnouts. Among the reasons for this are the fact that a turnout has more parts to get out of adjustment, and the further fact that it is subjected to certain stresses that other parts of the track do not have to resist. For these reasons, it is important that turnouts be watched closely to insure that defects do not develop and that they be given a thorough and detailed inspection at least once every week, and oftener if this is practicable.

One good way to inspect a switch is to start about 15 ft. ahead of the point and check the gage on joints, centers and quarters, through the main track

to a point 30 ft. back of the frog. Any tight or wide gage found should be corrected. The level board should be tried in about the same manner and any uneven surface found should be corrected.

D derailments at turnouts usually happen at the point of a switch, at the frog point or on the turnout behind the frog. A derailment at the point of a switch is generally caused by the points not fitting properly to the stock rail, or metal chipping off the top of the point. In the latter case, the flange of a wheel usually mounts the point and rides across it.

Accidents are sometimes caused by a combination of three things—vertical or sharp flanges, a blunt or flat place on top of the points and, occasionally, worn stock rails. For these reasons, switch points and stock rails should not be left in service when they are worn to the extent that they are not considered safe. A good switch point should never be placed against

*Abstracted from a paper presented at the fall meeting of the Maintenance of Way Association of the Kansas City Southern.



Soft Bottom, Smoke
and Heavy Traffic
Made the Work Par-
ticularly Difficult

To provide greatly enlarged clearances in its 3,800-ft. double track tunnel at Washington, D. C., made necessary by the electrification of its line between New York and Washington, the Pennsylvania lowered the floor of the tunnel from 36 in. to 54 in. In spite of a wet mobile soil, heavy traffic, and the presence of much smoke from locomotive stacks the work was carried out successfully in about 44 weeks' time.

WORKING under the handicaps of a wet mobile soil, heavy single-track operation, and oppressive, blinding smoke, the Pennsylvania has lowered the floor of a 3,800-ft. double-track tunnel under Washington, D. C., from 36 to 54 in. By lowering one side of the tunnel floor at a time, utilizing power equipment as much as possible, and guarding against side wall movements and the undermining or weakening of the operated track, the work was carried out successfully in about 44 weeks' time, without serious personal injury or appreciable delay to traffic.

The tunnel in which this work was done passes under the southeast side of the city, largely beneath Virginia Avenue, and carries all of the road's freight service around the Union passenger station to and from its classification yard and interchange with the Richmond, Fredericksburg & Potomac just south of the Potomac river. The work was done in connection with the electrification of the line between New York and Washington, which required greatly enlarged clearances in the tunnel. As a matter of fact, in spite of the substantial lowering of the tunnel floor, it was also necessary to single-track the tunnel in order to provide a minimum clearance of 17 ft. above the top of rail for the electric trolley wire.

The Virginia Avenue tunnel, as it is called, consists of two sections, a northerly unit 1,185 ft. long which was built in 1873 and 1874, and a southerly unit 2,617 ft. long built in

1903 and 1904, when the Pennsylvania began operating its passenger trains into the then new Union passenger station. The older section of the tunnel was constructed of rubble masonry throughout, while the newer portion was built with a six-ring brick arch above coursed masonry side walls. Both sections of the tunnel are in a clay which is highly mobile when wet, and which it has been very difficult to keep dry in spite of the installation of special subdrainage systems and the fact that the tunnel slopes generally south from a summit approximately 500 ft. in from the north portal. This in turn has made adequate track maintenance difficult and costly.

That special difficulty was encountered with soft ground and excessive lateral pressures while constructing the south 400 ft. of the original section of the tunnel was evidenced by the heavy one-man stone floor which had been placed in this section, and

Lowering a T Under T

The Mucker Used During a Part of the Work Had a Tendency to Mire Down in the Softer Sections



Tunnel Floor Traffic

also by the heavy timber cross-bracing found at places beneath the track grade while carrying out the present work. Furthermore, because of the unstable condition which existed in this area, the north 715 ft. of the 1903-04 tunnel extension had been provided with a concrete invert.

No Rock Encountered

No rock was encountered in the work of lowering the tracks and because of the depth of the section of concrete invert below the existing track level and the larger cross section of the tunnel at this point, it was possible to secure the necessary additional headroom without disturbing the invert. However, all of the stone floor and timber bracing in the south end of the old section of tunnel had to be removed. This was replaced with a new concrete invert at a lower level.

In carrying out the work, half of

the tunnel floor was first lowered throughout its length while traffic was maintained on the track on the opposite side. After this track had been thrown over on the lowered base between train movements, the second half of the tunnel floor was lowered. With both sides at the new low level and the floor partially ballasted across its full width, the single track was then lined to the center of the tunnel and surfaced at final grade.

In conjunction with the lowering work, a new subdrainage system was installed, the under side of the arch of the old masonry section was waterproofed and stabilized with a lining of gunite concrete, and large concrete ducts or envelopes were provided along the walls to carry the high-tension power lines of the electrification system. All of this work was carried out under a traffic of 45 to 50 trains each way daily, in addition to numerous work-train and yard move-

ments, creating a most difficult smoke situation. This smoke condition, which was occasioned both by the frequent train movements, especially those up grade, and the normally poor draft in the tunnel unless the wind is in the most favorable direction, invariably delayed the work for several minutes after the passage of trains, and often kept it at a complete standstill for a considerable period of time. All of the work was done under a manually-controlled absolute block system, with operators located at each end of the tunnel.

The first stage in lowering the floor of the tunnel was carried out on the southward side and was begun at the south portal. Here, following the removal of the southward track, a crawler-mounted, gasoline-operated shovel with a $\frac{3}{4}$ -yd. dipper loaded the material removed into $1\frac{1}{2}$ -ton auto trucks which were spotted alongside on the northward track. The trucks, which were moved into the tunnel in fleets of from 10 to 15 units between trains, operated on planking laid directly on the ties of the operated track up to a point just ahead of the shovel. After being loaded they turned off the track and proceeded northward to the north portal on the bed of the old southward track.

Trucks Operated on Track

Consideration was given to keeping the trucks off the operated track by having them approach the shovel over the excavated portion on the southward side, but since it was necessary for them to foul the operated track in any event at the shovel while they were being loaded and while passing

around the shovel, there appeared to be no reason for not allowing them to use the track all of the way up to the shovel and thereby take advantage of the better roadway which the planked ties afforded. Furthermore, it was found that the operation of the trucks

ing damaged by striking joint bars and bolts.

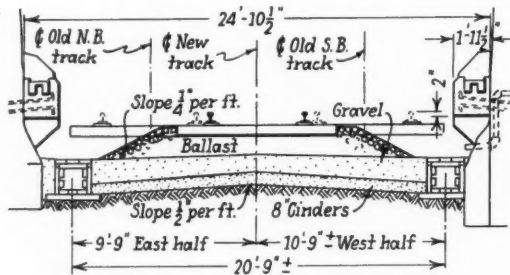
The old 715-ft. section of concrete invert was cleaned off by hand, the ballast material being loaded directly into trucks because of its relatively shallow depth. The north 700 ft. or

Throughout all of this work, in spite of the fact that the excavation was not carried below the wall foundations at any point, care was exercised to avoid any possible disturbance of the walls and of the operated track. Little trouble was given by the walls, but in many of the wetter sections, and at points where the excavation was the deepest, it was necessary to support the shoulder of the operated track with plank and heavy cross braces carried to the opposite wall in order to keep it in line and surface.

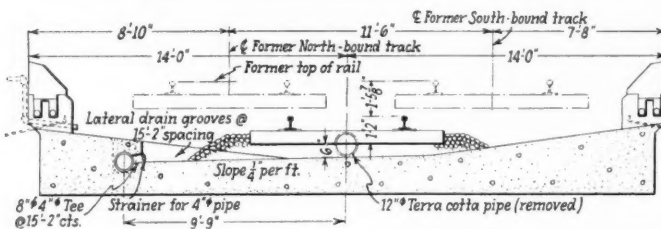
Installing Invert

While the floor was being lowered on the southward side, a 400-ft. section of new concrete invert was built on this same side directly north of the old invert. Because of the instability of the floor material and the danger of inward movement of the tunnel walls, this new invert was built in alternate sections of 15-ft. So far as possible, excavation for the new invert was done with a clamshell bucket, discharging directly into trucks, but much of the bottom of the excavated areas was leveled off by men shoveling into the clamshell bucket which was lowered into convenient position.

As the southward side of the tunnel floor was lowered, the new subdrainage system was installed on that side and eight inches of cinder sub-ballast was brought in in the trucks and distributed. When the work of lowering this side had been completed and six to twelve inches of gravel had been spread over the cinders, the operated track was lined over onto it, releasing the northward side for excavating.



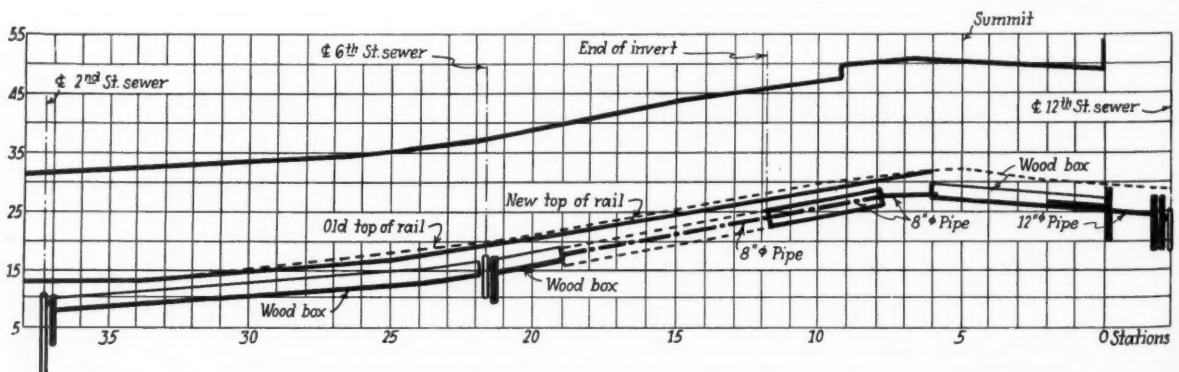
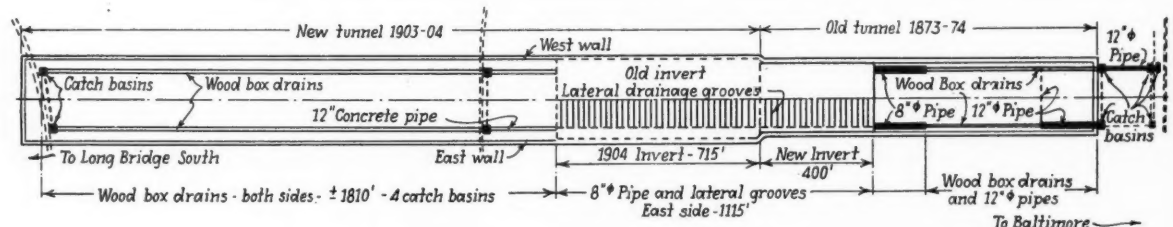
Left—Typical Section Through Older Section of Tunnel at North End. Below—Typical Section Through 715 Ft. of Existing Invert, Showing New Side Drain and Lateral Drain Grooves Cut in East Half



over the newly excavated floor had a tendency to create ruts and mud holes which would have been undesirable later in securing adequate drainage of the track subgrade.

The truck runway on the operated track was provided by three 3-in. by 6-in. planks laid on the inner ends of the ties, and a similar group of planks laid immediately inside the outer rail. Special mitred blocks at the rail joints prevented the truck tires from becoming

more of the tunnel floor on the southward side was excavated with a crawler-mounted crane equipped with a 3/4-yd. clamshell bucket, which loaded trucks backed into the tunnel on the southward side from the north portal. An attempt was made to use the power shovel in this latter section, but regardless of the care exercised in its operation, it had a tendency to catch and damage the rear of the trucks backed up to it for loading.



Plan and Profile of the Virginia Avenue Tunnel, Showing Details of the New Drainage System for the Lowered Floor

The excavation on the northward side of the tunnel was carried out in a different manner in order to release the crane and shovel and to employ another unit of equipment which would otherwise have been idle. This unit was a power mucking machine which had just been used in the construction of the double-track Union tunnel at Baltimore, Md. This unit discharges the excavated material at the rear by means of a conveyor, as it digs itself forward. It was effective in the areas of more stable subgrade in the tunnel, but had a tendency to mire down in the softer sections.

Narrow Gage Cars Used

The material from the northward side was removed by means of narrow-gage flat cars equipped with two-yard bottom dump boxes, which were hauled into and out of the tunnel by a battery-operated electric mule. The narrow-gage track included a passing siding behind the mucker so that empty cars could be moved up for loading as the loads were taken out.

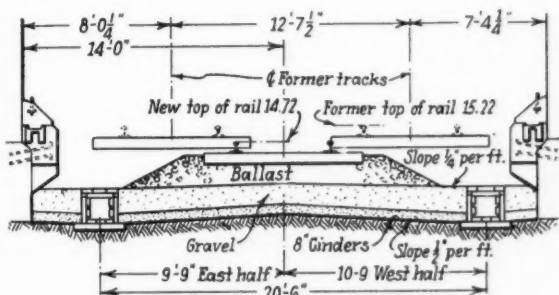
With no area in the vicinity of the south portal readily available for the disposal of the excavated material di-

tripped their contents into an elevated bin alongside, from which the waste material was drawn off into motor trucks spotted beneath.

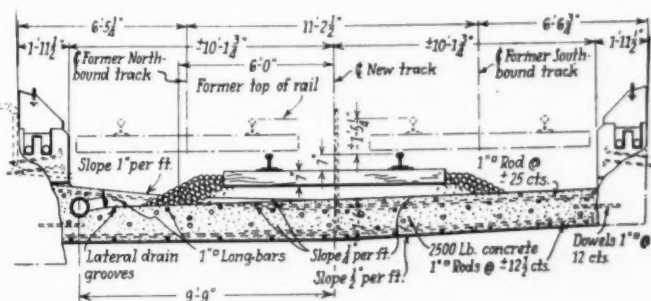
New drainage was installed in the northward side as the excavation proceeded, the old section of invert was

ballast bed. The track was then lined over by a succession of throws by gangs following one another, each increasing the throw until the track lay in the center of the tunnel. With this operation completed, which required only about two hours, the gangs were

Pouring the New Concrete Invert Provided in a Particularly Unstable Part of the Old Tunnel Floor



Left—Typical Section Through the Southern Portion of the Tunnel, Showing the Changes Made. Below—Typical Section Through New Section of Concrete Invert at the South End of the Older Section of Tunnel



rect from the narrow-gage cars, which required that it be hauled away for disposal elsewhere in trucks, a method of transfer of the material to trucks was devised which made it unnecessary for them to descend into and climb out of the deep tunnel approach cut. For this purpose, a heavy-duty crane with a 60-ft. boom was located at the street level directly above the south portal, which hoisted the loaded car boxes from the track level and

side had been completed, the single operated track was thrown to the centerline of the tunnel and was brought to the final grade and surface.

This work was carried on during the night in a period of light traffic by a force of approximately 160 men, divided into 5 or 6 gangs. As the first step in this work, a power track jack was sent through the tunnel to lift and shake the track loose from its

distributed through the tunnel and proceeded to surface the track sufficiently to permit the passage of trains, this work requiring approximately four hours. The track was restored to service approximately six hours after the lining work was begun. Later, working between trains, additional ballast was added and the track was brought to final grade and surface.

During the work of lowering the tunnel floor, the old drainage system, as already mentioned, was replaced with an entirely new system. Originally the north 500 ft. of the tunnel leading up to the summit at Sta. 5+00 drained northward through open ditches along the side walls. Beyond this point all drainage was to the south. Up to the 715-ft. section of old invert, which began at Sta. 11+85, the tunnel was drained by a line of 8-in. tile pipe along each wall, which, at the lower ends, led into a line of 12-in. tile pipe laid in the trough in the center of the old invert. Beyond the old invert to the south portal, drainage was again effected by side lines of tile pipe which emptied into city sewers beneath the tunnel at Sta. 21+58 and near the south portal at about Sta. 37+00.

In the new system of drainage, the open ditches at the north end of the tunnel were replaced by two wooden box drains of 12-in. by 13-in., inside measurements, as were also the lines of tile south of the old invert. These box drains, which were laid with their bases at the lowest level of excavation, were made of 2-in. creosoted lumber, with tight tops and bottoms, but with 1/2-in. slots between boards on both sides to permit the ready infiltration of water. The tops of the drains, which are not covered with ballast, were constructed in 2-ft. 8-in. re-

movable sections to permit ready inspection and cleaning.

Through the old concrete invert, the top surface of which sloped both ways toward the center, the new drainage system involves a single line of 8-in. tile along the east wall, with laterals of 4-in. cast iron pipe at intervals of approximately 15 ft. extending to the center of the invert. This necessitated cutting troughs in the invert to place the pipes at the proper level to insure complete drainage of the tunnel floor, but this could not be avoided since the single tracking of the tunnel at the lower level brought the ties not only directly over the center of the invert, but also so close to it as to afford no room for a line of pipe through the center. All of this work was done with pneumatic jackhammers.

Having decided to place the drainage system on the east side through the old section of invert, a similar system of drainage was provided along the east side of the new 400-ft. section of invert directly to the north. Here, the main drainage line of 8-in. tile pipe, with inlets and cleanouts at intervals, was installed at the proper level as the invert was poured, and

troughs were formed in the east half of the invert at the proper intervals to house the lateral pipes.

The waterproofing and stabilizing of the tunnel was confined to the old masonry arch section at the north end and consisted essentially of providing new weep holes and of applying three coats of gunite cement to form a new interior lining approximately $\frac{3}{4}$ -in. thick. In general, the method of carrying out this work was similar to that employed in the road's 7500-ft. Baltimore and Potomac tunnel at Baltimore, which was described in detail in *Railway Engineering and Maintenance* for February. However, because of the smaller amount of work done in the Virginia Avenue tunnel, the equipment employed here was not as extensive or as elaborate as that employed in the Baltimore tunnel.

The work in the Virginia Avenue tunnel was planned under the direction of Robert Faries, assistant chief engineer, maintenance, and A. R. Wilson, engineer bridges and buildings of the Eastern region, and was carried out by the electrification forces under the general direction of J. V. B. Duer, chief electrical engineer.

able moisture. At this time it may be expected that the track will go out of line and surface rapidly and persistently.

When the rains have stopped and the subgrade has drained to the point where the plasticity of the material is reduced substantially, the track will hold its line and surface for a time, but this favorable condition will likely be of short duration. If the dry weather continues, the gumbo on the surface of the shoulder and slope of the embankment dry out and shrink. When this occurs, the roadbed almost invariably develops cracks parallel with the track and well inside of the ballast toe line, allowing the ballast, particularly if it is sand or gravel, to settle into the opening. As the drying progresses, the cracks open wider and strike deeper, creating center-bound track which is likely to go out of line and surface as readily as during the wet period. In general, this effect is more pronounced on high than on low fills.

For these reasons, since gumbo swells and becomes plastic when wet and shrinks and deteriorates through splitting when dry, this material presents a serious problem of stabilization of the track and roadbed under these recurring phenomena. It is obvious that water is at the seat of the trouble and that it must be kept from the subgrade, or removed if it is not feasible to keep it from entering. To accomplish this stabilization, two courses are open:

1. A good quality of stable soil, such as silt or black dirt, which will act to shed any water that falls on the roadbed, can be used as a topping for the subgrade if this is practicable and the cost will not be unreasonable. Obviously, this can best be done at the time the subgrade is constructed, and is one of the best forms of insurance against later trouble.

Lateral Drains

2. If the first method has not been applied and if water has entered the roadbed, the important thing is to remove it as rapidly and effectively as possible. This can best be done by lateral drains, which may be of the French type or of perforated corrugated pipe. Tile should not be used in gumbo because it is so easily distorted by movement of the plastic material. Likewise, longitudinal drains between tracks are seldom effective, because they are also likely to be distorted and raised above grade by the plastic movement of the material, thus destroying their usefulness. It is important that both the lateral drains and the outfall drainage line be of ample

(Continued on page 367)

Stabilizing Gumbo Roadbed

By E. E. Barton,

Roadmaster, Chicago & North Western, Rapid City, S. D.

IF the roadbed is unstable, it is impossible to maintain the track in either good line or surface. While many kinds of material enter into roadbed construction and many factors cause instability, it is generally conceded that gumbo is the most difficult material upon which to maintain track. This type of soil is widely distributed throughout the Mississippi valley and is found in some sections beyond the boundary of this drainage area.

An outstanding characteristic of gumbo is the fact that when it is wet, it is tough and sticky, but plastic to a high degree; while when dry, it breaks up into hard lumps, or in large masses, and shrinks to a greater extent than most other earths, opening up with wide cracks. It often occurs in the form of stratified clays which resemble shale in appearance and hardness, and is often found in cuts where it is classed as shale. Furthermore, while

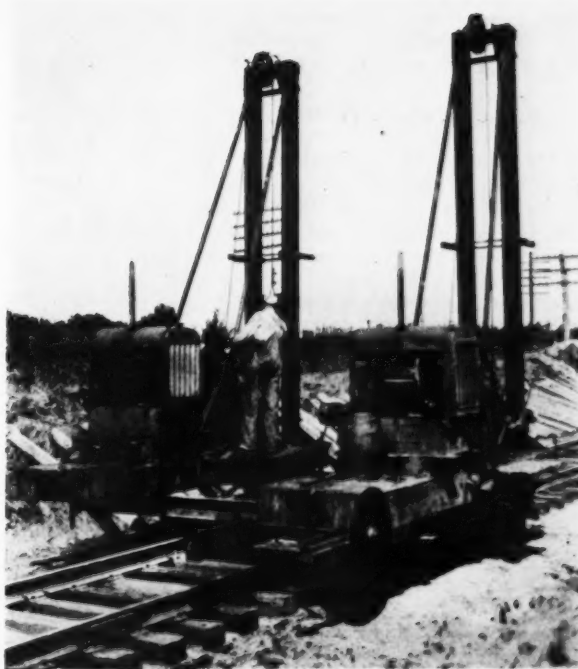
gumbo absorbs water with comparative ease and holds it tenaciously, it resists the passage of excess water through its mass.

Because of these characteristics, embankments built of this material are exceedingly prone to develop water pockets. In fact, it is almost impossible to avoid them, and slides often result from the impounding of the water in the pocket as the surrounding area becomes saturated. Likewise, water pockets develop in gumbo roadbed in low fills and in cuts, unless proper drainage has been provided at the time of construction.

Movement of Gumbo

After a water pocket has once formed, there is a constant movement of the gumbo from the bottom of the pocket toward the shoulder of the fill, which can be detected easily, particularly since it sometimes amounts to as much as 8 to 10 ft. Naturally, this movement is most pronounced during wet weather when the soil surrounding the pocket has absorbed consider-

Subsurface palisades formed by driving cull ties into the roadbed along each side of the track have proved an economical means of reducing the cost of maintaining line and surface across water pockets. Applied as a makeshift at various times in the past, the method has been thoroughly tested by a western road and is being applied extensively on its lines.



A Machine Designed Especially for the Driving of Ties

A Novel Cure For Water Pockets

THE practice of driving cull ties into the roadbed as a means of stabilizing track across water pockets is by no means new, as it has been employed at various times and places in past years. But these earlier applications have been more or less sporadic, representing expedients adopted on a small scale, usually on the initiative of some roadmaster or section foreman, to meet conditions existing in isolated cases. More recently one road has applied this method on a broad scale after careful observation of the results obtained in test installations.

The process is simple. The ties are driven vertically through the ballast and into the roadbed along each side of the track as close to the ends of the ties as the driving apparatus will permit. The spacing in the longitudi-

nal direction is 18 in. center to center, and the ties are driven down until the top end is below the bottoms of the track ties so as not to interfere with crosstie renewals.

Produced Results

As stated, this practice was adopted because experience has shown that it affords a large return in the form of reduced expenditures for track maintenance. So-called water pockets in cuts cause unstable track because during wet seasons, the material comprising the roadbed becomes semi-fluid. Water-saturated material that is subjected to pressure tends to flow or move in the direction of least resistance. In the case of a roadbed, which is subjected to vertical pressures pro-

duced by the track loads, the material flows laterally, forcing its way out into the side ditches or upward at the shoulders. The depression or settlement of the track structure at a water pocket is, therefore, proportional to the extent of such lateral displacement.

As seen in the typical cross-section of a roadbed, the ties driven through the water pocket and into the solid material underneath form a pair of retaining walls that tend to resist this lateral movement. It has been contended also, that the ties have the effect of compressing the material in the water pocket, but whether this has any permanent influence is not known.

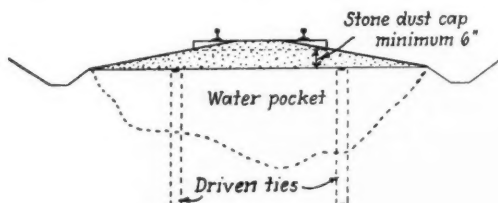
In the application of this process, the track has in some cases been covered with a more or less impervious

seal consisting of a layer of chatts or rock dust treated with a coating of oil. However, this is not an essential feature of the plan.

Drainage Common Method

Drainage is the obvious and most commonly applied means of curing water pockets, since the removal of the water restores the material to a condition that enables it to resist compression without lateral displacement. However, there are conditions under which drainage presents serious obstacles and is exceedingly costly; for example, the problem presented in removing water from a pocket, say, 60 ft. long at the upper end of a cut 1,000 ft. long.

It was to meet conditions of this kind that the initial experiment with tie driving was applied. In some cases the track conditions were such as to require some attention by the track forces almost daily, and, while in the majority of the situations the conditions have been far less severe, the amount of extraordinary maintenance



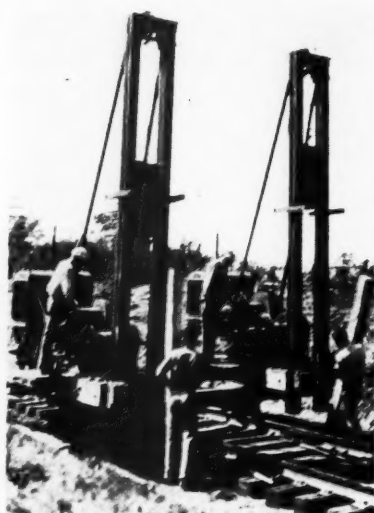
Above—The Two Rows of Piles in Relation to a Water Pocket

At the Right—The Two Driver Rigs set off to Clear for Trains

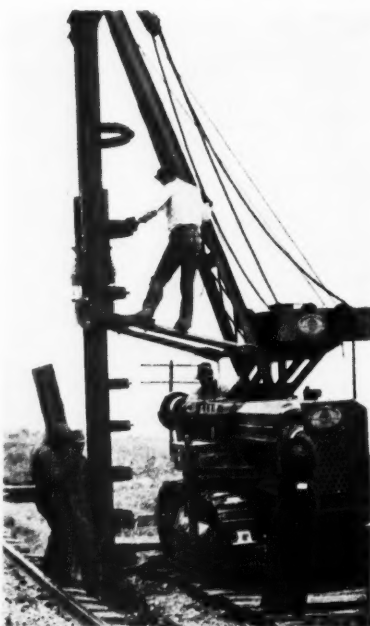
has been such that any improvement in conditions promised rather attractive savings. Experience has substantiated these conclusions. The return on the investment in many cases has amounted to as much as 100 per cent in the form of reduced outlay for track upkeep in the first year.

Machines Used

As only the most primitive methods of driving the ties had previously been employed in the adaptation of the process to water pockets, it was necessary to develop some thoroughly effective means. On the road which has developed this method most fully, most of the tie driving has been done by contractors, who have been given a free hand to use their ingenuity in devising driving equipment. Various machines have been used; among these the standard track-mounted pile driver was tried and found entirely too expensive. Others include a driver mounted on a crawler-tread tractor and a small-scale model of the mud-



Driving Two Piles at the Same Time



Another Type of Tie Driver

skid pile driver. These are examples of the adaptation of existing types of equipment to this particular purpose, but more recently one of the contractors has developed a machine designed especially to meet the particular requirements of this operation.

A Track Driver

This machine is essentially a track driver, since it is mounted on flanged wheels to obtain the greater mobility that is afforded by traveling on the track. But this has involved the necessity for means of removing it from the track quickly, which has been worked out in an ingenious manner. However the most distinctive feature lies in the fact that it is equipped with duplicate leads and hoists so that ties

may be driven along both sides of the track simultaneously. In addition to doubling the rate of progress, this arrangement has an advantage in that it results in less disturbance of the track than is the case when the ties are driven along one side of the track at a time. The driving of the ties into the roadbed distorts the track as to both line and surface to an extent that requires the placing of a 25-mile slow order until the section gang can correct the resulting irregularities, but with the ties driven on both sides simultaneously the line is not so seriously disturbed.

The driving equipment is mounted on a special steel-frame four-wheel car, the main element of which is a pair of transverse beams 14 ft. long that support the drivers directly over the desired locations of the two lines of ties. Each driver rests on a heavy mat of timbers spanning longitudinally across the tops of these beams. Leads of steel and wood 18 ft. high are supported on one end of these mats, while behind each pair of leads

is a 35-hp. Waukesha gasoline engine connected directly to a Clyde Iron Works double-drum hoist. One drum on each hoist handles the 2,500-lb. drop hammers, while the second drum on one of the machines is employed in operating the chain drive to one of the axles for moving the car along the track. The extra drum on the other hoist operates a belt drive to a circle saw used in cutting off ties.

This outfit can be run along level track at a speed of seven miles per hour, but the speed is ordinarily limited to five miles per hour with the drivers in the working position. When the machine is being moved over the line from one job to another, the drivers are set closer together on shorter transverse beams so as not to encroach on the normal operating clearance.

The rig for the removal of the drivers from the track embraces four 8-in. wide-flange beams, reinforced with plates on each side to form additional webs, and provided on top with 1-in. by 1½-in. steel strips welded longitudinally along the center line. These strips serve as the guide for a roller dolly, the four-inch rollers of which are grooved to engage this strip. After the beams have been blocked up on each side of the track the dollies are rolled under the drivers with two small screw jacks resting on top of each dolly. The jacks are then turned up to raise the timber mats clear of the supporting beams, after which the drivers are rolled to clear on either side of the track. A turntable has been provided for the removal of the car after the drivers have been taken off. In practice, these driver rests are placed at the lower end of the cut in which the work is in progress to take advantage of the greater speed of travel in the downhill direction.

The Force

The force employed by the contractor comprises five or six men and a foreman. Two men operate the hoists, two men set up the ties under the hammers and one or two men shovel out the ballast at the location of each tie. The number of men required for this last operation depends on the ballast section; if the ties are fully boxed two men are needed. In addition to this force, the railroad employs an inspector, and two railway employees are on duty as flagmen, their wages being paid by the contractor. A portable telephone set is provided for connection with the dispatcher's wire, so that the work may be planned with maximum information as to train movement.

The progress made with this outfit depends on the extent of traffic interference, the time lost in moving from one water pocket to another, and the ease with which the ties are put down. As a result, the number of ties driven per day varies from as few as 50 to as many as 700.

The ties or timbers used in this work are available at an average cost of about 15 cents. The cost of driv-

ing them by contrast averages around 20 to 25 cents. In general, the cost of the ties in place, including the transportation and distribution, is around 80 cents per tie, so that with ties on each side of the track at 18-in. centers the cost of this treatment of water pockets is about \$1 per track foot. This does not include the cost of applying an impervious cover of chatts or stone coated with oil.

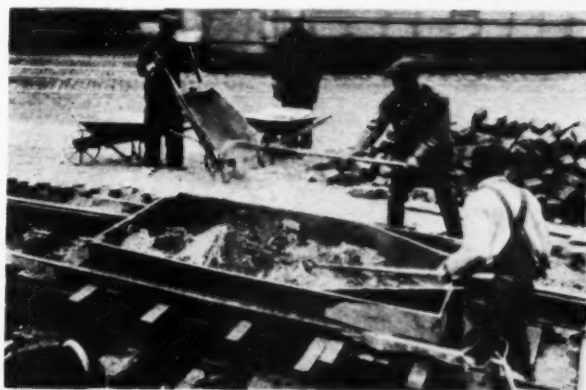
Provides Grouted Base for Track in City Street

BY resorting to grouting in providing a load-distributing base for a track in a city street, the Baltimore & Ohio, in a recent project, accomplished the desired stabilization of the roadbed without going to the expense of building a mixed concrete base under the track. The same project was also of interest because of the simple, economical and expeditious manner in which the work was carried out.

The location of this project is a single-track line on President street in Baltimore, Md., which serves a warehouse and industrial district near the waterfront. The track construction embraces fully tie-plated wood ties carrying 9-in. 150-lb. girder rails, while the street is paved with granite blocks on a concrete base. As the subsoil in the vicinity is normally saturated with moisture and has a limited load-carrying capacity, the track, which is subjected to rather frequent switching movements, manifested a considerable degree of instability. As a frequent surfacing of the track was objectionable because of the heavy expense involved

in tearing up and replacing the pavement and also because of the interference occasioned to both vehicular and railroad traffic, it was decided to effect a permanent solution of the problem by installing a grouted foundation under the track for a distance of a block on President street.

(Continued on next page)



Left—Mixing the Grout. Above—Illustrating How the Grout Was Poured Directly from the Mixing Box

In this work, which was done by a crew consisting of a foreman and five track laborers, the necessary amount of paving was taken up and the existing ballast was removed to a depth of from 8 to 10 in. below the bottoms of the ties. This excavation was then back-filled up to the bottom of the



Some of the Grout Was Poured From a Bucket

ties with crushed stone ballast ranging from 1½ in. to 2½ in. in size, after which the grout was applied to the crushed stone in the manner described below. The remaining courses were three in number and included a 2-in. layer of screenings applied on top of the grouted material, a concrete slab extending to within 5 in. of the top of the rail, and the 5-in. granite block wearing surface. In conducting the work care was taken to insure that the track was given the proper line and surface. Throughout the entire operation the track was in active service.

In carrying out this project the work was planned in such a manner as to afford a minimum of interference with vehicular traffic. The grout, which was proportioned on the basis of a bag of cement to about 1½ cu. ft. of damp, loose sand, was mixed in a mortar box which was supported on the rails on skids, thus permitting the grout to be deposited directly into the crushed stone from the box.

Constructed of 1-in. lumber, the mortar box was 1 ft. deep, 4 ft. wide and 8 ft. long and was provided with an opening 12 in. wide in the center of one end through which the grout was discharged. To facilitate the discharge of the mix a chute arrangement was provided at the outlet end by boards inserted diagonally across the corners. During the mixing of the batches the outlet was closed by

a removable wood gate 15 in. wide, in which the vertical edges were beveled to provide a tight fit against the sides of the chute. When in use the mortar box was supported on the rails by means of timber cross pieces, while, to permit ready handling of the box to and from the track, two-by-fours were nailed to the sides to provide a handle at each corner.

The grout was batched on the basis of two wheelbarrows of sand (each containing nine shovelful) and three bags of cement, while the water was added directly from a hose, the amount needed being judged by observing the consistency of the mix. The mixing was done, in the usual manner, using shovels, hoes and a hoe-shaped four-tine fork having a leather strap fastened across the ends of the tines.

When a batch had reached the proper consistency the gate was re-

moved and the grout discharged directly onto the crushed stone between the ties, the mix being constantly agitated while the box was being emptied. When necessary, buckets were used in obtaining the desired distribution of the grout. Sufficient grout was considered to have been placed from any one setting of the mortar box when the mix became visible in the voids of the crushed stone in the next crib. When this condition was attained the mortar box was moved forward on the rails to the next setting and the process repeated. That complete penetration was obtained is demonstrated by the fact that computation of the amount of grout used per foot of track checked closely with an estimate of the voids in the stone.

By this method grout was applied to 150 to 200 ft. of track per day at a cost of 11 cents per track foot.

When an Abutment Tips*

By A. R. Ketterson

Assistant Engineer of Bridges
Canadian Pacific, Montreal, Que.

WHEN an abutment begins to give evidence of tipping, an immediate investigation should be made to discover the cause and to determine whether it is feasible to strengthen it against further movement at less cost than that of completely rebuilding it. It should be borne in mind at this time that much of the preliminary work that will be necessary is common to both schemes.

In general, the first step is to relieve the abutment of as much of its superimposed load as is practicable. A support should be placed in front of it to carry the reaction of the span, and it will generally be advisable to drive a short trestle of two or more bents, the number depending on the height of the fill, behind the abutment to take the live load off of the fill and thus relieve the back of the abutment of live-load surcharge. These precautions will not only relieve the abutment of the principal extraneous forces acting upon it, but they will also reduce vibration, which is an important consideration, especially if underpinning is to be involved.

*This discussion was submitted for publication in the What's the Answer department of the February issue, but because of its scope, it was withheld for presentation here as an independent article. For further discussion of this subject, see page 95 of the February issue.

Except when caused by scour, the invariable reason for the tilting of an abutment is excessive toe pressure, that is, a toe pressure greater than the carrying power of the soil in the foundation. For this reason, the main objective should be the extension of the toe in such manner as to insure that this extension will have its proportion of the total load transferred to it from the existing masonry.

This extension will then function as a continuous buttress extending along the face of the abutment, and consideration should be given to whether its foundation should be slightly above or at the level of the existing footing, or whether the excavation should be made deep enough to permit the foundation of the extension to be carried in underneath the existing footing. The latter will involve underpinning, which always calls for the exercise of a high degree of good judgment in both the preliminary arrangements and the actual execution of the work. This is particularly true when dealing with a unit which has already shown definite indication of tilt.

An important consideration is that of shoring the abutment against further tilt during the execution of the work. This is especially so when underpinning a substructure unit which has already become displaced. Sometimes physical conditions at the site make it feasible to install timber

shores sloping from a recess cut in the concrete near the level of the bridge seat down to a solid foundation in the foreground. Where there is deep water in front of the structure, this is not practicable, however, except at considerable expense. In some cases, it may be possible to adopt a scheme whereby the span itself can be used effectively as a shore.

Whether or not the work contemplates underpinning, assuming that piles can be used, before excavation is started several rows of piles should be driven in front of the abutment. The number of rows to be driven will depend on the distance the extension is to be carried out in front, but this should be not less than will engage two rows of piling. If underpinning is contemplated, the inside row should be driven as close to the existing footing as practicable.

Before any concrete is placed, it is suggested that deep horizontal grooves be cut in the face of the abutment at intervals of about six feet. The upper side of the groove should be approximately horizontal and the lower side should have a slope downward of about 30 deg. with the vertical. These chases should extend the full length of the abutment and will form keys or shoulders for the new concrete.

If the abutment is an important one, and especially if the footing course of the extension is not carried under the existing masonry, it is advisable to cut down the bridge seat to a depth of at least 12 in. and replace it monolithically with the extension. Longitudinal and closely spaced lateral reinforcing rods should be placed in the new bridge seat and the latter should be bent down in front to be wired to the vertical rods in the extension.

It is also advisable to drill dowel holes in the face of the abutment on about 3-ft. centers, both vertically and horizontally. These holes should be drilled at a slight angle, so that when the dowels are grouted into them, before the forms are erected, they will slope upward into the extension.

If the footing course of the extension is carried under the toe of the existing footing, then, to insure the least possible disturbance to the soil under the abutment, the excavation should be carried out in short sections, starting with the one at the center. Each of these sections should be concreted and the concrete allowed to harden before another is excavated. Obviously, if the abutment is long and the soil is of such character that the excavation of one section will not influence the consolidation of the soil at one remote from it, work on both should be carried on concurrently.

It is necessary that the greatest care be exercised when excavating under

the present footing to insure that a "run" does not develop that will impair the consolidation over a greater area than that being excavated. To guard against such a contingency, the sides of the section should be bulkheaded securely and the concrete should be placed immediately after the excavation is completed.

To a considerable extent, the distance that the new footing should be carried under the existing one will depend on the cohesive characteristics of the soil. On the other hand, it is useless to underpin a structure unless the underpinning can be carried back far enough so that the shear value of the existing footing is sufficient to transmit that quota of the estimated pressure which the extension has to carry.

As an example, if an abutment has only one footing course 2 ft. thick, projecting 1 ft. from the body, the new footing should be carried in under the body itself. In the event that there are several footing courses, however, the new course need be carried back only to the point where the shear value of the combined existing footing courses is sufficient to transmit that portion of the total pressure which must be taken by the extension.

A liberal amount of reinforcing should be placed in the new footing course. The rods which project from under the existing masonry into the new toe should be of large diameter and should be grouped over the piles. If available, short sections of old rail are especially suitable for this purpose.

Owing to the fact that the extension must be carried out in short sections, the longitudinal reinforcing will also generally be of relatively short sections. The ends of these bars can be allowed, however, to project through the bulkhead into the adjoining unexcavated sections, so that these ends can be wired to the short lengths placed in those sections or they can be hooked securely to them. If stout rods are employed, there is usually no difficulty in driving them into the adjoining soil through holes provided in the bulkheads.

No account has been taken in the foregoing as to whether the work is to be carried out in the wet or in the dry. It has been assumed that if it is

the former, a coffer dam has been constructed around the abutment before actual work on the footing has been started.

To make work of the character under discussion effective, the new footing should either be carried well under the existing masonry or the bridge seat should be cut down and replaced monolithically with the extension. If the abutment is a large one carrying a heavy span, it will probably be better to do both. Otherwise, the extension must depend largely, if not exclusively, on the bond between the new and old concrete and on the dowels for its stability. This gives no assurance that after a lapse of time any appreciable load will be transferred from the original masonry to the extension.

This discussion has assumed that the tilt of the abutment has not progressed beyond the point of practicable and effective reinforcement, so that rebuilding need not be considered. The determination of this point is a matter of judgment based on experience and on relative costs.

Gumbo Roadbed

(Continued from page 362)

size and on sufficient grade to insure quick collection and rapid runoff of the water.

Where either of these methods is used, the track should be maintained to the best advantage until the subgrade has become fully stabilized. Ballast can then be applied without further danger of water pockets, provided care is used in making the application.

When applying the first method, the volume of the topping should not be skimmed. To obtain satisfactory results, the topping material should be applied from shoulder to shoulder of the subgrade to a depth of, say, 20 in., and should be well compacted.

In conclusion, the difficulties which are encountered in maintaining track on gumbo result from excess moisture getting into and remaining in the roadbed and the characteristic plasticity of the gumbo when wet, as well as from the after effects when the surface of the roadbed dries out. If excess moisture can be kept out of the roadbed by any method, gumbo will ordinarily be as stable as any other material. If it is not practicable to keep the water out, the next best thing is to develop means for removing it rapidly and effectively, after which the track will soon become stabilized.



How Many Ties?

AN ANALYTICAL study of the tie renewals of the railways during the last four years, in comparison with their needs, and a forecast of their requirements for the immediate future, were incorporated in a paper prepared by Julius H. Parmelee, director, and Graham E. Getty, assistant statistician, Bureau of Railway Economics, Washington, D. C., and presented by Mr. Getty before the eighteenth annual convention of the Railway Tie Association at Cincinnati, Ohio, on May 20-21.

In this paper the authors pointed out that at the end of 1935, there were approximately 1,038,000,000 cross-ties supporting 348,300 miles of tracks owned and operated by Class I steam railways in the United States. That number represented a decrease of 28,000,000 ties from the aggregate in track at the end of 1930, the peak year. The decline was due principally to the abandonment of rail trackage during the period. In addition to track laid with crossties, there were 24,250 miles of tracks laid with switch and bridge ties. The number of such ties approximated upwards of 100,000,000.

The number of crossties laid in replacement and the number laid in new lines and extensions during the last 15 years just about equal the number now in track, plus ties removed from abandoned lines. That does not mean that every tie in track at the beginning of 1921 has since been replaced, for some ties laid in 1921 and subsequent years have since been replaced because of expired service life, defects, or damaged condition, leaving an equivalent number now in track that were laid prior to 1921. For the moment, however, we merely indicate an average service life of 15 years per tie, based on the period 1921 to 1935 as a whole.

Because of increasing average service life the number of tie replacements decreased somewhat each year from 1922 to 1929. Because of economic conditions the rate of decline since 1929 has been much more rapid. Thus, of the ties laid in replacement during the last 15 years, 61 per cent were laid in the first $7\frac{1}{2}$ years and 39 per cent in the second $7\frac{1}{2}$ years. The weighted average of expired service life of ties now in track is slightly more than 9 years per tie. The renewal rate at the beginning of the period was 8.5 per cent annually of the aggregate number in track,

while at the end of the period it was 4.3 per cent.

In 1934, for the first time in many years, crosstie renewals exceeded the number laid in the preceding year. Again, in 1935, renewals increased, representing an increase of 19.4 per cent over the low point of 1933, but a decline of 40.6 per cent from the level of 1929.

In order to indicate the trend of the last four years, we quote the following statistics. For comparative purposes, we give also figures for the year 1929.

Year	Number of ties laid in replacement	Ratio to total ties in track
1929	74,679,375	7.0%
1932	39,190,473	3.7%
1933	37,295,716	3.5%
1934	43,306,205	4.1%
1935	44,351,900	4.3%

It will be recalled that the ratio of tie renewals for a number of years prior to 1929 was distinctly downward, due to increasing use of treated ties, with a resulting increase in aver-

The high standard of train operating safety throughout the period of economic depression gives that statement considerable support.

As traffic returns to the rails, however, we may expect an increase in tie renewals. As earnings permit, a maintenance reserve comparable to that of 1929 will undoubtedly be built up, but for the present we may only expect a maintenance program consistent with traffic and safety demands. That demand today is greater than at any time since 1931. During the first quarter of this year the Class I carriers increased their maintenance of way expenses by nearly 20 per cent over the same quarter of 1935, and by nearly 50 per cent over the corresponding quarter of 1933. A part of the increase was due to higher wages, a part to increases in material costs, and the remainder to an expanded maintenance program. We think we can expect the renewal of close to 50,000,000 crossties this year, an increase of about 12.5 per cent over 1935 and an increase of 34 per cent over 1933. About four-fifths of the ties laid this year will be treated ties.

What about future years? As each

There Is No Substitute for Good Ties



age service life per tie. Even if economic conditions had remained unchanged from 1929 to date, the carriers would not have been making renewals today at the rate of 7.0 per cent annually. Taking that fact into consideration, as well as the fact that the decline in traffic reduced the amount of wear and tear on ties, and further that abandonments have eliminated some 28,000,000 ties from tracks, it is apparent that from the maintenance standpoint tie renewals since 1929 have not been so far below pre-depression standards as the bare figures seem to indicate. That there has been some deferred maintenance is undoubtedly true, but it is equally true that deferred work may not have gone beyond the reserve that had been built up by the end of 1929.

year passes we consume over one billion tie years of service life. At the renewal rate of the past four years, ties would have to average 25 years of service life in order to balance the annual service consumption. That average is undoubtedly high. At an average of 20 years of service life per tie, the carriers would annually require about 50,000,000 ties. Again, we believe that average life may be high because about one-fourth of the ties laid during the past four years were untreated. However, at present traffic levels, 50,000,000 tie renewals annually seems to be the indicated trend. If traffic increases and earnings improve, it may be necessary to replace 60,000,000 ties annually, in order to build up a maintenance reserve comparable to 1929.



Hot Creosote for Adzed Ties

Is it worth while to paint the adzed surfaces of treated ties with hot creosote? What are the advantages? What practical method can a gang employ to heat the creosote?

Well Worth While

By L. H. HARPER

Superintendent Creosoting Plant, Central of Georgia, Macon, Ga.

It is well worth while, under some circumstances, to paint the adzed surfaces of treated ties with hot creosote. The purpose of pressure treatment is to enable the ties to resist decay for many years longer than they would if they remained untreated. During the life of the tie it is sometimes necessary, incidental to gaging, straightening rail, laying rail with a wider base or applying larger tie plates, to adze under the rail or tie plate seat. In doing this, the untreated portion of the wood may be exposed, thus leaving it with no protection and inviting decay. In this way the tie will likely be destroyed long before full benefit can be derived from the original treatment. In such cases, an application of hot creosote on the adzed areas before the new tie plates are put on, will delay the attack of decay-producing organisms at the most vulnerable part of the tie and thereby aid in prolonging the service life of the entire tie.

While it must be understood that nothing so far discovered will take the place of pressure treatment, or even approach it in value, it is a fact that some species of wood, southern pine for example, when thoroughly dry, will absorb considerable creosote from a surface application. The value of such treatment depends to a large degree, however, upon the care which is exercised in preparing and applying the liquid. The adzed surfaces should be well cleaned and the creosote very hot. Two or three applications should be made, with sufficient

time between for the oil to soak in.

With the wide adoption of machine adzing before treatment, the necessity for adzing new ties to obtain a level bearing for the rail or tie plates has been practically eliminated. Where such adzing is required, however, the adzed surfaces should be protected by an application of hot creosote. When derailments occur the ties in the track involved in the accidents are usually cut or bruised by the wheels. If this is not so bad that the ties must be removed from the track, the damaged places can be adzed to remove the crushed fibres and present a smooth surface, after which an application of hot creosote should be made.

Creosote can be heated in convenient-sized cans or drums by building a fire beneath them. Care should be exercised, however, to avoid filling the vessel too full or building too big a fire. Otherwise, the flame may reach the liquid and set it on fire.

Prefers Cold Creosote

By W. H. SPARKS

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

No one contends in these days that adzed surfaces of treated ties should not be painted with creosote. There

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered in August

1. *When renewing ties, should the new ties be tamped as they are inserted or the tamping be left until the day's allotment of ties has been inserted? Why?*

2. *What causes concrete floors to dust? What can be done to overcome the trouble?*

3. *Under what conditions is it desirable to cut a rail without removing it from the track? How can it be done?*

4. *What is spotting, as applied to paint surfaces? What can be done to prevent it? What factors affect this?*

5. *What benefits are derived from the destruction of weeds? What is the importance of each?*

6. *What causes chattering in a valve? What can be done to prevent it? Does chattering affect the accuracy of water meters? Why?*

7. *Where the rail is tight, what methods should be employed in surfacing track out of face? Why?*

8. *How can steel sheet piling be made watertight?*

are many who believe that the creosote should be hot when it is so applied. Yet, in many cases, there are practical difficulties connected with the use of hot creosote that cannot be overlooked.

When ties are treated, the preservative is forced into the wood under pressure with the twofold purpose of getting the deepest practicable penetration and of making certain that enough of it will be retained within the wood cells to resist decay. Experience has shown, however, that the greatest retention is found in a narrow zone close to the surface of the tie. Beyond this zone, the amount of preservative decreases rapidly, for which reason an adzed surface is seldom as resistant to decay as the original surface was.

On the other hand, a tie is rarely adzed deep enough to expose un-

treated wood. The application of the fresh creosote on the surface is, therefore, in the nature of a precaution to insure a higher resistance to decay, not to create a resistance that did not previously exist, since it is applied to wood that already contains some creosote.

Again, the application is made on a top horizontal surface where the creosote does not run off but remains until it is absorbed into the wood. I am not convinced, therefore, that hot creosote will penetrate any deeper into the wood than creosote that has not been heated, although the hot creosote will probably be absorbed more quickly. This may not be true in the winter, and it may be desirable to heat the creosote during cold weather, but I am not convinced that it is necessary to do so during the normal working season, especially during the hot months.

Every trackman has observed ties that have surface checks, many of which extend deeper than the plane to which ties are normally adzed, while split ties are found on every railway with which I am familiar. We do not apply creosote to these ties, although it might be economy to do so in some cases. Certainly the loss from surface checking and splitting is as great, and possibly greater, as the loss from adzing. I am at a loss therefore, to understand why we should insist on heating the creosote for application on the adzed surfaces when we ignore these other avenues for the entrance of decay-producing germs.

Assuming that it is desired to heat the creosote, two problems are presented. The first is that of a small gang that is gaging, possibly in connection with tie renewals straightening rail, etc. Such a gang will work within somewhat restricted limits day by day, and will need only a small amount of creosote. For this reason, a small kettle can be used both to heat the creosote and to convey it to the point of use. Care should be exercised to avoid building too hot a fire under the kettle, for creosote ignites easily in the presence of a flame.

The second problem is that of a large rail gang that moves from one to two or more miles a day. In this case stationary heating equipment is out of the question, and it will be necessary to mount the heater on a push car which can be moved along at the same rate as the rail crane. Otherwise, serious delays are likely to occur in delivering the preservative at the point where it is needed. This form of heater makes one more piece of equipment to get off of the track when trains must be cleared, and at the end of the day.

Not Worth While

By THOMAS WALKER
Roadmaster, Louisville & Nashville,
Evansville, Ind.

I doubt very much whether it is worth while to paint the adzed surfaces of ties with hot creosote. The protection thus afforded is only superficial, since the preservative cannot be expected to penetrate to a sufficient depth to offer protection for a long period. Ties are subject to considerable mechanical action, for which reason there is a measurable amount of

wear which can be counted on to destroy this superficial protection shortly, beneath the tie plates, at least where ordinary track spikes form the fastening.

In track where the tie plates are fastened securely to the ties independently of the rail fastening, there may be some advantage in painting the surfaces with hot creosote. In the ordinary run of track, however, I believe that the average section gang would be wasting time in applying creosote, which could be used to much better advantage on other work.

Cleaning Out Storage Tanks

How should one proceed to clean out wayside storage tanks? How should the mud or sludge be disposed of?

By an Auxiliary Pipe

By R. N. FOSTER
Water Engineer, Wabash,
Decatur, Ill.

Many flat-bottomed wood tanks are equipped with an auxiliary opening which is kept approximately flush with the floor of the tank. When it is desired to clean the tank, a temporary trough is erected to carry away the sludge as it passes through this opening. The water is then drawn down through the conventional outlet serving the water columns, until it reaches a level a few inches above the sludge. The valve protecting the auxiliary opening is then opened, and the remaining water with most of the mud and sludge runs out into the trough. What is left can then be shoveled to this opening where, since it is generally semi-liquid, it passes out easily. Enough water should then be pumped into the tank to flush the floor and at the same time wash the sludge out of the trough.

If the tank is near a track and considerable mud has accumulated, it may be desirable to run the sludge into a tight-bottom car, where it can be allowed to dry, after which it can be unloaded at some point of satisfactory disposal. If the car cannot be held, a car partly filled with cinders will filter the mud from the water, and the mud and cinders can be dumped at some convenient point. It may be that the tank is so located on high ground that a small drainage ditch to guide the waste water and sludge away to a lower level will be all that is necessary. Another way, where the mud must be removed from the vicinity but no track is convenient, is to construct a box underneath or close to the tank

and allow the sludge to run into it and remain until dry, after which it can be disposed of as conditions permit.

Steel tanks having conical bottoms are equipped with mud drums which can be connected with a sewer or a special drainage outlet. In this case, periodical flushing of the tank will prevent an appreciable accumulation of mud or sludge in the mud drum. A certain amount of mud adheres to the side of the tank and to the conical bottom, however, which should be removed at longer intervals. In doing this, the water is drawn down to the mud, which is scraped off and washed down into the mud drum, thence out through the drain valve. Care should be exercised to insure that the mud is not forced into the mud drum too rapidly, as this may stop the drain. The maximum amount of water available should be used when scraping down the sides and flushing the tank.

Uses Auxiliary Opening

By G. C. EDWARDS
Master Carpenter, Erie,
Paterson, N. J.

When a tank is to be cleaned, the inlet is closed a sufficient time in advance to allow the water to be drawn down through the regular delivery to locomotives, until the tank is almost empty. If the demand has not been sufficient to use all of the water in the tank, the remainder is wasted through the water columns or the tank delivery valves as the case may be.

In wood tanks, a wash hole approximately 6 in. in diameter is provided in the floor, so located that it comes between floor joists. As soon as the tank

has been emptied, two men wearing rubber boots and using brooms, sweep the sediment through the wash hole. After the bulk of the accumulation has been removed a small amount of water is let into the tank to assist in washing out the remainder. Our tanks are cleaned frequently, so that the sediment does not become hard, making it necessary to resort to shovels or other tools.

After the tank has been cleaned thoroughly, the washout hole is closed by means of two circular iron plates, each $\frac{1}{2}$ in. by 8 in., with rubber gaskets. A $\frac{3}{4}$ -in. bolt through the center of the plates permits the assembly to be drawn.

In cleaning out a steel tank, the water is drawn from the tank through the washout valve which discharges into a special drain. The manhole at the bottom of the tank is removed and the sediment is cleaned from the steel surfaces by means of a small shovel and pails. Water is then let into the tank and the surfaces are thus flushed several times until all sediment has disappeared.

Disposal of the sediment, whether mud or sludge, is generally an individual problem for each tank. For this reason, there is no general rule, except that it should be wasted at any convenient point where its disposal will be satisfactory.

different parts of the rail become very bothersome. Well-laid new rail, whether plumb or canted, is, therefore, easier to line than old rail, and all lining is easier when the sun is low than when high. Most men prefer to line with the sun at their backs. When the sky is overcast, lining is always easier than when the sun is shining.

Easier to Line Vertical

By W. H. SPARKS
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

In the first place, our heavier rail sections have a head of so much greater width than the older and lighter sections that this, in itself, makes lining more difficult than formerly. When rail sets upright or is given the slight cant employed on most roads, the passing wheels polish the surface along the gage edge of the head, and there is, or should be, no particular difficulty in lining the rail other than that which is imposed by the width of the head.

It is well known, however, that in time the cant of a canted rail tends to increase. This may reach the stage, particularly on lines carrying a heavy traffic, where the wheels bear more on the outer part of the head, leaving unpolished spots or ribbons along the gage edge, which are quite confusing to the eye and, obviously, lining becomes more difficult.

I believe that most trackmen will agree that a rail which has only the normal amount of cant usually given in the tie plates, can be lined with the same ease as a rail that is vertical. Where the cant is increased, however, whether by design or otherwise, lining may be much more difficult.

Lining Vertical and Canted Rail

Can a rail be lined more easily when it is vertical or when canted? Why? Does the amount of cant make any difference?

Makes Little Difference

By E. L. BANION
Roadmaster, Atchison, Topeka & Santa Fe, Independence, Kan.

Canting of the rail, to provide a wider contact between the locomotive and car wheels and the running surface of the rail, is a widespread practice today. This cant is effected by inclining the rail seat on the tie plates.

It has been my experience that rail can be lined more easily when it sets vertically. On the other hand, in practice, the canting is so slight that in most cases it is scarcely noticeable in its effect on lining. It has been noticed, however, that on sharp curves, where the rail tends to assume a decided cant under traffic, the additional cant thus created may seriously affect one's ability to line this rail. It can be said, therefore, that while vertical rail is somewhat easier to line, no particular difficulties are encountered unless the cant is increased over that placed in the rail by the design of the tie plates.

An Acquired Technic

By C. H. Vögt
Track Supervisor, Central of New Jersey, Jersey City, N. J.

The ability to line rail is acquired, since it is a development of the visual sense. While it is an acquired, rather than a natural, technic, some men develop greater ability to line than others. Being acquired, the canting of the rail is a thing apart and the ability to line rail is not affected in any way

by the way in which the rails are set.

There are optical illusions which the accomplished liner must allow for and endeavor to overcome. Every person who has lined track has noticed how shadows of trees or buildings across the track tend to throw him off. The top and the gage edge of the rail are highly polished surfaces which reflect sunlight, often in a confusing manner.

This reflection on old rail makes satisfactory lining quite difficult, because after years of service the rail does not set uniformly plumb or to a uniform cant, as the case may be. Again, the wear may not be uniform. The result is that the variation in the angle of reflection of the light from

A High Lift or a Light Lift?

When reballasting, under what conditions should track be given a high lift? A light lift? Why?

Several Reasons for Each

By C. G. FULNECKY
Assistant District Engineer, New York, Chicago & St. Louis, Frankfort, Ind.

When reballasting, there are a number of conditions which make a high lift desirable. The most important of these are (1) where the old ballast is foul and churning; (2) when laying new rail on track which has not been surfaced recently and in which the ballast is worn out and dirty; (3) when changing from an inferior grade of ballast to a better grade, say from

cinders to stone; and (4) when making a grade revision in which the track can be raised economically on ballast.

While the reasons for making a light lift are not so numerous, far more track is given a light lift every year than a high lift. Among the more important conditions indicating the desirability of a light lift are (1) the out-of-face surfacing of track that is center bound; (2) where tie renewals are heavy enough to warrant a light raise to facilitate the work; and (3) where old ballast that shows signs of becoming foul can be saved by a light raise, with new ballast

placed in the cribs and on the shoulder.

It has been assumed that the depth of the existing ballast is ample to meet all load-carrying requirements, for which reason kinds of ballast, ballast depths, weight of rail and other collateral conditions, including train speeds and density of traffic, which might influence the decision between a high and a low lift have not been mentioned.

Track Needs New Life

By DISTRICT ENGINEER

This is a question which is particularly pertinent at this time when indications point to a more liberal use of ballast in the immediate future. Owing to conditions with which we are all familiar, reduced appropriations have placed severe restrictions on the use of ballast since 1929. As a result, the average age of the ballast in the tracks of the roads as a whole is considerably greater than it was in 1929. As the period between renewals is extended, it becomes of added importance that the amount of lift the track should receive should be given serious study, with a view to balancing the results with the funds available for applying the ballast.

In making this study, a number of considerations must be kept clearly in mind. In the first place, a certain amount of resilience in the track is beneficial, since it will aid in absorbing the shocks to equipment. This is exemplified by the fact that frozen track seldom rides as smoothly and the damage to equipment is greater in the winter than when there is no frost in the roadbed. It is the common experience that track which has not been raised for a long time loses its resilience and becomes "dead," after which it cannot be made to ride well, even with repeated routine surfacing. Center-bound track is another condition which cannot be overcome permanently by mere surfacing, since it follows logically from dead track, except occasionally on unstable roadbed or where the ballast shoulder is slack.

Where either of these conditions exists and the ballast is clean and of sufficient depth, a lift of two or three inches is generally sufficient to restore the track to good riding condition, provided the ballast shoulder is ample. Again, where tie renewals are heavy, the track should be given a light lift, say two inches, at the time the renewals are made. This will eliminate much rough track after the tie gang has passed.

Not infrequently ballast that is apparently clean will start to churn if the track has not received a general

surfacing for a long period. Where this happens, a light lift, with hand cleaning at the points where churning is beginning to develop, may overcome the trouble and delay the necessity for a major application of ballast for several years.

Obviously, if the ballast is of insufficient depth, the track should be given a higher lift to provide the proper load distribution on the roadbed. If the ballast is stone and is foul, as it is likely to be, it should be cleaned before the new ballast is applied. If it is gravel, the old ballast should be thrown out on the shoulder of the roadbed. In either case, a minimum lift of six inches on new ballast will probably be necessary, with still greater lifts through sags.

A variety of ballast-cleaning equipment is available today, which enables

maintenance officers to recondition track by cleaning the ballast and making a light raise, which a few years ago would have required a major ballast application. On the other hand, this practice cannot be continued indefinitely, since it will eventually become necessary to make a high lift, not only to replace the old ballast, but to eliminate the uneven surface which invariably develops under this practice, despite repeated general surfacings.

Where the track is rebalasted in connection with a rail program, and its condition is such that only a general surfacing would have been necessary, a light lift for the new rail may be sufficient. On the other hand, where the rail needs renewal, other track conditions are usually not of the best, and a high lift may be required.

When Old Stone Masonry Fails

When an old stone pier or abutment begins to fail through breakage of the individual stones, what can be done to arrest the progress of the disintegration and to repair the damage?

Would Renew Structure

By CHARLES P. DISNEY

Bridge Engineer, Canadian National,
Toronto, Ont.

Generally speaking, when an old masonry pier or abutment starts to fail from the disintegration or crushing of the individual stones, the failure can be traced to the fact that the structure was designed perhaps 50 or more years ago, for loadings that may have not been more than 20 per cent of those imposed today. In many cases, too, one finds that the construction, despite some of the eulogies we hear about the old-time engineers, was anything but honest and well carried out. Furthermore, almost without exception, when a stone abutment is in this condition, we find that it has been built on a bad foundation, the usual practice having been to lay a bed of square timbers on which to start the cut stone. These timbers were never fastened together; they were usually placed in dry ground above the water table and have, for the most part, disintegrated, thus allowing the courses of masonry to get out of line and to spread.

While there are cases where it might be economical to save an abutment of this kind, in 99 per cent of the cases it is a waste of money to endeavor to do so. From my own viewpoint, based on extensive experience with such structures, the cheap-

est and best procedure is to design a new structure of sufficient size and capacity to carry the modern loads which are being imposed. Having designed the new structure, it is our practice to design the necessary falsework, usually consisting of timber bents and steel or timber beams, to permit removing the existing substructure, at the same time maintaining traffic. We then place this falsework, which of necessity must be substantial to handle traffic even temporarily, and leave it in place for 8 or 10 years, or until such time as it is approaching the end of its service life and we have made an adequate return on the money invested in it. The old structure is then torn out and rebuilt.

I am aware that not a few railways are wasting a lot of money in letting their bridge and building forces plaster or, as they call it, point old masonry structures. Usually, this pointing is worse than useless, as it is not even done with a cement gun but by hand. However, as already suggested, there may be cases where it is economical to make the effort to repair old masonry which is failing in the manner stipulated in the question, although it has been my experience that such cases are rare.

Tremendous sums of money have been wasted in the past in efforts to save such structures by patching and pointing the old masonry. Most of this money would have been better spent if it had been used to replace

these structures with new designs which were able to carry the heavier train loading of today.

Depends on Cause

By L. W. Skov

Office Engineer, Chicago, Burlington
& Quincy, Chicago

The remedy will depend on the cause of the disintegration. In those structures where a small percentage of the individual stones have deteriorated considerably more than the remainder owing to these stones being of poorer quality, they can usually be taken out and replaced with concrete. Where the deterioration is general, however, encasement in concrete, which is well bonded to the original masonry with dowels, may be effective. Where vertical cracking of the individual stones occurs in piers as a result of loading and vibration, this action can sometimes be arrested by placing heavy steel bands made from T-rails or similar sections. These bands should be so designed that they can be drawn up tightly on all sides. If the pier is more than 20 ft. long, the band should be held in position by means of rods through the piers and clamped to the rail to prevent the possibility of spreading. Where piers are encased in concrete, particular attention should be given to excluding the entry of water between the concrete and the stone. In some cases this may require that the pier be capped with concrete.

Assigns Four Causes

By GENERAL BRIDGE INSPECTOR

I have had to contend with numerous failures of this type for which I have been able to assign four causes, namely, (1) overloading, (2) weathering, (3) poor foundation and (4) "skinning the job."

Where overloading occurs there is usually little that can be done except to replace the structure, although it is sometimes possible to extend the footing and jacket a pier. This is less often feasible with an abutment, although it can be done in some cases where the masonry is otherwise sound. If foundation conditions are difficult it is probable that it will be cheaper to replace the structure than to try to extend the foundation.

Most stone piers and abutments were built prior to 1890, about which date concrete was beginning to displace stone. While much of the stone that was used in these structures was of excellent quality and has resisted

weathering well, the age of the structures is such that more or less deterioration has taken place, and the inferior grades of stone have failed or are now failing. In many cases this action is being hastened by the fact that present loading is far in excess of that for which the piers were designed. Where only an occasional stone or the upper courses are failing it is often possible to remove them and replace them with concrete. Not infrequently a relatively thin encasement of concrete will protect the structure from further deterioration, but where this is done it is well to consider the desirability of grouting under pressure to insure homogeneity of the original masonry.

If the foundation is poor or overloaded it is generally more economical to replace the structure than to attempt to salvage it. Most stone piers

and abutments rest on timber grillages, some of which are partly decayed, making underpinning both expensive and uncertain as to results. On the other hand, where conditions are favorable, this may be the best solution.

Not a few failures in substructures have occurred because the original construction was "skinned." It was not uncommon in the days of hectic railway expansion to construct the exterior courses of piers and abutments with excellent cut stone and then fill the interior with spalls and pour enough natural cement grout over them to fill the voids. I have seen some cases where ungrouted sand was used for this filling. Many of these structures are still standing, but when they start to fail they go rapidly, and there is no alternative but to replace them with new structures.

Uniform Elevation on Curves

What measures are necessary to insure the maintenance of uniform elevation on curves? What is the importance of each?

A New Viewpoint

By DISTRICT ENGINEER

Uniform elevation on curves has always been recognized as important, but a fuller appreciation of this importance is being stimulated by the growing tendency to shorten train schedules to the point where speeds far in excess of those we have been accustomed to are becoming quite common.

Minor irregularities in the elevation of a curve which might be barely noticeable at 40 miles an hour, may cause extreme discomfort to passengers when the speed reaches 80 or 90 miles, or more, an hour. For this reason, where high-speed trains are being operated, it becomes necessary to develop an entirely new viewpoint with respect to the maintenance of curves. It might also be well for some of us who have not yet been called on to prepare for these shortened schedules to be giving consideration to the subject.

In the first place, the roadbed must be stable and the ballast of sufficient depth to distribute the load to the subgrade or uniformity of elevation cannot be maintained. As a corollary, only sound ties should be allowed to remain on a curve, for neither surface nor gage can be maintained to the proper standard unless the rail has a solid bearing.

Line, gage and surface are so in-

terrelated that defects in one will be communicated to the others, with detrimental effect on the riding quality of the track. Line is particularly important, however, since only a slight divergence from the correct alinement may create a marked difference in the radius of curvature. In this case, if the elevation is uniform around the curve, it will not be the correct elevation for that part which is out of line, and the cars may be given a severe side swing. This is just as essential on the spirals as on the body of the curve itself.

String lining is the most practicable method of maintaining perfect alinement around a curve. Through this method small defects which are not readily apparent to the eye become obvious and can easily be corrected. It has the further advantage that it can be used by most foremen, and if the foreman is unable to master it, the supervisor certainly will be able to do so.

If uniform elevation is to be maintained it is essential that the track level be used constantly, not only when working, but at other times to check conditions. It is never safe for a foreman to rely on his eye, for small variations in the elevation of a curve are seldom detected visually.

Another important point for consideration is the amount of elevation. In the past, there has been a tendency to apply too much elevation, with the result that it was excessive for all

but a few trains. Excessive elevation makes it difficult to maintain uniform elevation and equally difficult to maintain gage and line. The life of the low rail is definitely shortened by the additional load it must carry during the passage of slow trains; the ties are damaged by repeated gaging and regaging; and much labor is wasted in the effort to keep the curve in repair.

Drainage Is Essential

By DIVISION ENGINEER

I would put drainage as the first essential to the maintenance of uniform elevation on curves, for no track can be kept in good surface unless the roadbed is well drained and solidified, and rests on clean ballast. The next requisite is sound ties, this being specially important for the maintenance of gage, since both line and surface are affected adversely by poor gage, and correct gage cannot be maintained on poor ties.

The third essential is that the elevation be chosen to conform to the traffic. It is true that in all but a few cases curve elevation is a compromise, because trains differ widely in speed, but it should not be overlooked that too much elevation is likely to be harder on the track and equipment than too little, that is, within the ordinary limits of practice. In general, the elevation which gives comfortable-riding conditions for the fast trains should not be too great for the slower speeds on curves, say, up to 2 deg. For sharper curves it is better to restrict the speed of fast trains than to introduce elevation that will be excessive for slow movements.

The remaining measures are purely those of routine maintenance. If uniform elevation is to be maintained it is essential that the foreman always use the track level when surfacing. Small variations in elevation cause the cars to roll, while those of greater magnitude result in severe lurching or side swings which may cause passengers to become apprehensive. The use of the level should not be confined to periods of surfacing, however, for the elevation should be checked frequently with the track level.

Joints should not be neglected. The bolts should be kept tight, the ties well tamped and the gage to standard. The joints in the low rail tend to give more trouble than those in the high rail, but both are important. Loose joints not only cause discomfort to passengers, but they spoil what would otherwise be good line and surface.

Smooth line is as important in the maintenance of uniform elevation as

any of the factors which have been mentioned. Even small defects in the line of curve will cause severe lurching at speed, and this tends not only to increase the distortion of the line, but to affect the surface as well. Every time any work is done on a curve care should be taken to adjust the line, for

although the elevation may be correct and uniform for the degree of curve which has been established, even a small variation in the line may make considerable change in the degree of curvature and the elevation will not be correct for that part of the curve which is out of line.

Deeper Ties on Open Decks

When installing deeper ties on open-deck bridges, what procedure should be followed? What precautions should be observed with respect to the passage of trains?

Precautions No Different

By H. AUSTILL
Bridge Engineer, Mobile & Ohio,
St. Louis, Mo.

To answer the last question first, in renewing ties on open-deck bridges with ties of deeper section, the same precautions with respect to the passage of trains should be observed as in any case of tie renewals. It has been my practice to use a wooden shim about 16 ft. long, of the same width as the base of the rail or of the tie plate, dressing it down with an adze to form a wedge with a feather edge. This can be slipped under the rail, or tie plates, to form a runoff, provided the difference in depth between the new and old ties is about 1½ in. and the rail is not too stiff. The ties can then be renewed out of face as far as time between trains will permit. When necessary to prepare for the passage of a train, one row of spikes for each rail is pulled, the others are eased off and the shim is inserted for a runoff onto the old deck.

If the increased depth of the new ties is greater or the stiffness of the rail will not permit so short a runoff, the track should be jacked up all of the way across the bridge and wooden shims about 16 ft. long and of the proper thickness to bring the rail to the new grade, inserted between the bottom of the ties and the stringers. These shims can then be removed in sections as the new ties are inserted.

Procedure May Differ

By GENERAL INSPECTOR OF BRIDGES

In general, the method to be followed will depend on the frequency and speed of trains, the weight of the rail, the length of the bridge, the difference between the old and new ties and whether slow orders will be tolerated. If the bridge is a short one

on a branch line where trains are infrequent, it is often possible to remove the rails and renew the ties without making any provision for the passage of trains during the progress of the work.

If the bridge is longer and the work cannot be completed between trains, the procedure will then depend on whether slow orders are permitted, the weight of the rail and the difference in the depth of the old and new ties. If the rail is a light section, say 90 lb. or less, it will be flexible enough to admit of a relatively short runoff, the length of which will in turn depend on the additional depth of the new ties and the minimum permissible speed.

Assuming that a slow order can be effected, a wedge-shaped shim should be prepared for insertion under the rail on the old ties to provide a runoff from the new ties. This should not be greater than at the rate of 3 in. to the rail length, for which reason the shim should be not less than 11 or 22 ft. long for differences of 1 and 2 in., respectively. This type of runoff should not be employed where the adjustment is more than 2 in., or where train speeds are not reduced.

On main-line high-speed track, slow orders should be avoided if the work can be done safely without resorting to them. Aside from speed, main-line rail is likely to be so stiff that a short runoff will kink it. For these reasons the method of changing the ties will differ from that on a branch line. In this case, the rail should first be raised to the new elevation over the full length of the bridge by inserting shims either on top of the ties or between the ties and the stringer. This then permits the change to be made in the same manner as if the new and old ties were of the same dimensions. In other words, it becomes an ordinary renewal job. This should be done regardless of the length of the bridge or the depth of the new ties.

I prefer to do the shimming direct-

ly under the rail on steel spans, since this eliminates the use of hook bolts or other means of holding the ties and shims in place, while the shims are in plain view for inspection. They should be of hardwood and of sufficient thickness to permit removal of the tie plates which thus become readily available for application as the new ties are installed.

If the change is to be made on a timber trestle, which occurs less often than on a steel span, it may be better to insert the shims under the ties, placing one over each stringer. They can be made of the same length as the panels. If the ties are renewed a panel at a time, the shims are simply pulled out when the old ties are re-

moved. If the interval between trains does not permit this, however, they can be made in shorter lengths or a shim can be inserted under each tie, or in an emergency the longer shims can be sawed in two when necessary to close the track. In any event they should be of sufficient thickness to permit removal of the tie plates.

If the work is done in the manner outlined, the precautions to be observed are the same as those required in any ordinary job of renewing bridge ties. This will include a lineup of trains and flagging. It will be particularly helpful if the gang is provided with a portable telephone set, to enable the foreman to keep in touch with the dispatcher.

What Makes Putty Crumble?

What causes putty to crack and shake out? How can this be prevented?

May Be Poor Quality

By A. L. BECKER
Architect, Missouri Pacific Lines,
Houston, Tex.

Glass and putty comprise only a small part of the total cost of a building, while the actual cost of the materials is small, compared with the labor involved in applying them. If these materials do not prove satisfactory, however, the resulting dissatisfaction, annoyance and expense may be entirely out of proportion to the original installation cost.

For these reasons, care should be exercised to clean the wood thoroughly and prime it with white lead and oil to prevent it from absorbing any of the oil from the putty. After the priming coat has dried thoroughly, a thin layer of putty should be spread on the rebate of the open sash and the glass pressed into it until it has an even bearing. Next, the glass should be secured in place by means of glazier's points, spaced approximately 6 in. apart. The final application of putty to fill the rebate is then made.

Where no particular brand is called for, the common commercial putty which is generally used for setting glass, is frequently of very poor quality. For this reason, the owner should specify a putty made of soft amorphous-chalk whiting, linseed oil and not more than 10 per cent of white-lead paste. Amorphous-chalk whiting absorbs oil readily and retains it permanently, producing a putty of velvety texture, which has a smooth surface that is easily painted.

Adding not more than 10 per cent of white-lead paste will cause the putty to adhere sufficiently to prevent it from shaking loose. A larger amount of white lead will cause the putty to dry too hard and adhere so firmly to the rebate as to make reglazing difficult without damaging the muntins. As a further protection against drying and cracking, the putty should receive three coats of lead and oil paint of the best grade.

Usually Poor Materials

By INSPECTOR OF BUILDINGS

To be dependable, putty should be made of pure whiting, which is an amorphous chalk, and pure linseed oil. Poor materials, adulteration or substitutions, always result in an inferior product, such as the ordinary stock material or commercial putty. Whiting is sometimes adulterated with marble dust to increase its weight. If an inferior oil is used it will dry out and the putty will crack and fall out. Furthermore, if petroleum is used as an adulterant, the putty will crumble in the presence of water.

Many putty failures can be traced to faulty workmanship. Only first grade material should be used and the wood surfaces should be well cleaned and painted with white lead and linseed oil which has been thinned to a priming consistency. After the priming coat has dried, a relatively thin coat of putty should be spread uniformly on the bottom of the rebate and the glass pressed firmly into it.

As soon as the glass is bedded evenly, it should be secured with glazier's points, and the rebate filled with putty. The sash should be handled carefully until the putty is well set and ready for painting. As a protection, which will increase its life, the putty should be painted with lead and oil when the sash is painted.

The proper bedding of the glass and the firmness with which it is secured will have much to do with the life of the putty, for if the glass is held loosely in the rebate or the sash rattles in the wind, even the best of putty will crack and fall out. On the other hand, if the sash is tight and the glass is well secured, good putty properly applied and protected with paint should last for years. Again, the priming coat is important since dry unprimed wood will rob the putty of its oil, cause it to crumble and reduce the bond between putty and wood.

If a small amount of white lead, say not more than 10 per cent, is added to the whiting, the putty will be much tougher and more velvety in texture. The white lead will also increase its adhesion to the wood surfaces, even to the extent of making it difficult to remove. If more lead is used, however, the putty will become extremely hard when dry and may form a bond with the wood, which cannot be broken.

It should be understood that the foregoing discussion refers only to the use of putty with wood sash. Where putty is to be used with steel sash, a special product containing litharge will give far better results.

Precautions Not Taken

By E. C. NEVILLE
Bridge and Building Master, Canadian
National, Toronto, Ont.

In general, putty cracks and falls out because the surface on which it is applied is so dry that it absorbs the oil from the putty, robbing it of its elasticity and cohesiveness. All new sash should be primed thoroughly before the glazing is done; otherwise, the putty will soon dry out and will crack and crumble, allowing moisture to enter between the putty and the glass, and thus cause the putty to fall out. When renewing the glass in an old sash, it is also a good policy to apply a coat of paint to fill up the pores in the dry wood before resetting the glass. Following this, after the putty has become firm, the outside surface should have a coat of paint to protect it from the weather. If these precautions are taken, there should be no trouble from putty cracking or falling out.

New Products of the Manufacturers

Colored Valve Wheels

IN order to permit ready identification of valves in various classes of service, Jenkins Brothers, New York, has developed a new type of valve wheel which is molded of colored plastic materials. The new wheel, which is furnished in five standard colors—blue, red, black, green and gray, can be had either unmarked, or with any one of five standard service markings molded on the top in relief.



Valve Equipped with One of the New Covered Colored Wheels

In addition to their practical advantage in identifying valves in various pipe systems, it is claimed that the new wheels are strong, cool to the touch, easy to grasp, sanitary and permanent in color.

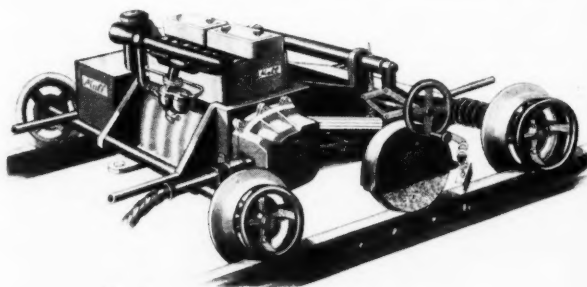
All Purpose Grinder

A NEW all-purpose rail grinder has been introduced by the Mall Tool Company, Chicago. Mounted on a four-wheel carriage, this grinder is powered with a four-cycle, air-cooled gasoline engine which develops 12 to 16 hp. at speeds ranging from 1,400 to 2,500 r.p.m. Power is transmitted to the grinding wheels by means of a

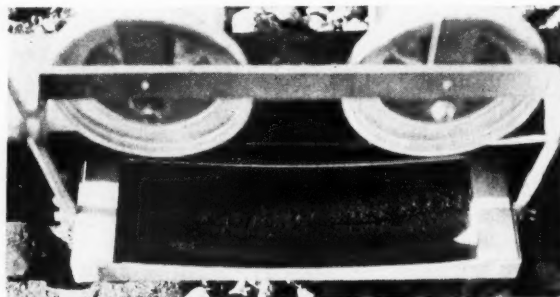
series of four V-belts through the countershaft. The peripheral speed of the grinding wheel, which is 14 in. by 1½ in., is said to be about 9,500 ft. per min.

A feature of this grinder is the positive toggle precision grinding wheel feed. Due to this feed and the

The New Mall
All-Purpose
Grinder



rigid steel chassis, it is said that the grinding wheel is adjusted to an accuracy of 0.003 in. A power take-off is provided to permit a flexible shaft to be attached quickly for free hand cup-wheel grinding, rail-end slotting and switch-point grinding. This machine will grind over a transverse dis-



View of a Horizontal Split Web as Reflected by the Mirror of the Sands Rail Inspector.

tance of 14 in. Other features of the grinder are a pivot turning device to permit the grinding work to be changed quickly from rail to rail; a waterproof magneto; an air filter; an adjustable governor; and aluminum wheels with cast-steel rims. The capacity of the gasoline tank is 10 gal., and the total weight of the machine is 600 lb.

Rail Inspector

THE MAGNETIC Signal Company, Los Angeles, Cal., is marketing a rail inspecting device, known as the Type 804 Sands rail inspector, which, through the agency of a magnifying mirror, makes it possible for the op-

erator to obtain a clear view of the underside of the head and the web of the rail while standing in an erect position. In this device the mirror is mounted, by means of two adjustable arms, on a dolly consisting of two double-flanged rollers arranged in tandem, the unit being pushed along

on the rail by an adjustable handle. As the operator pushes the device along, he watches for defects on the underside of the head of the rail by noting the reflection in the mirror.

The magnifying mirror is curved and ground both crosswise and lengthwise to provide magnification without excessive distortion, the image of the rail reflected by the mirror being ap-

proximately double actual size. The position and angle of the mirror can be adjusted readily to adapt it to the operator's vision and to various weights of rail. By means of a folding joint and a pin connection at its

lower end, both provided with wing nuts for tightening, the pusher arm of this device is adjustable at two points so that operators of varying heights can readily adapt it to their particular needs.

ardless of length or cross-sectional dimensions, delivered at Bayou des Allemands, La.

Sections were five miles long. My duties included the assignment as track walker. I carried an outfit of tools consisting of 1 short-handled maul, 1 cold chisel, 1 wrench, a few bolts, some spikes, copper wire taps and a small oil can.

I began working for the Southern Pacific in 1874, when I was 14 years old, on section No. 7 at Bayou des Allemands. The wages were \$1 a day and the day lasted from sunup to sundown. We lived in camp and paid \$14 a month for board, and every man was required to provide himself with a long-handled spade. We did our own washing and chopped up old ties to keep warm during the winter. We hunted ducks and rabbits on Sunday, and coons—the four-legged variety—on Saturday nights. Yet everyone was contented and happy.

CHARLES WEIGEL.

What Our Readers Think

Some Early Experiences

Elgin, Tex.

TO THE EDITOR:

In looking over some old copies of *Railway Engineering and Maintenance*, I ran across an editorial on loose bolts on page 537 of the November, 1933, issue. This discussion aroused memories of my early days on the Southern Pacific.

About 1870, we had a master mechanic named Tilden in charge of the shops at Algiers, La., who designed and built a car about the size and shape of a push car, upon which he installed a small upright boiler and an engine, together with some power tools which will be mentioned. This was known as a punch car.

At that time the rails were of wrought iron, with chairs used only at the joints. Those on our road were of two sizes, $3\frac{1}{4}$ and $3\frac{1}{2}$ in. high, respectively. Two designs of chairs were used to hold them in place, no other joint fastening being employed, since the chairs were intended to hold them in horizontal alinement. One of these chairs had a smooth bearing surface for the base of the rail; the other had a transverse lip or step about midway of this surface, and acted like a modern compromise joint to bring the running surface of two rails of unequal height to the same elevation.

Sometimes, however, one or both rails would creep enough to become disengaged from the chair. The primary purpose of the punch car was, therefore, to prepare the rail ends for the application of an additional joint fastening which would act as a splice and thus overcome the difficulty of wide joint gaps and offset rail ends.

In operation, the chair was removed and the spikes were raised for some distance back of the joint to allow the rail to be lifted enough to slip the punch under the ball of the rail. The engine was then started and two holes for bolts were punched in each rail end. While this operation was under way, the dirt was being dug from under the ends of the ties.

After the punching was completed over a section of track, the power was transferred to a shaft which had a circular saw at each end, the saws were lowered and the ends were sawed off the ties to bring them to a standard length of 10 ft. In those days the ties were 12 and 13 ft. long, some of them having bearing faces 2 ft. wide, these latter generally being inserted at the joints. The timber was cypress, and we paid 30 and 35 cents a tie, re-

New Books

Roadmaster's Proceedings

PROCEEDINGS of the Roadmasters' and Maintenance of Way Association of America for 1935, 162 pages, $6\frac{1}{2}$ in. by $9\frac{3}{4}$ in. Bound in cloth. Published by the Association, 319 North Waller Avenue, Chicago.

This volume contains the record of the fiftieth convention of this the oldest association of maintenance of way officers in America, for which reason considerable space is devoted to papers of an historical nature which were presented at a special evening session.

As in past years, the convention program included five committee reports and several papers and addresses. The subject matter of the reports covered the Handling and Distribution of Ties; Ballasting and Resurfacing Track; Recent Developments in the organization of Track Forces; Maintenance of Tracks in Terminals—Organization, Materials and Methods; and Maintenance, Reclamation and Repair of Frogs, Switches and Other Track Material. The papers included Today's Transportation Picture, by G. S. Fanning, chief engineer, Erie; Track Maintenance, by C. J. Geyer, engineer maintenance of way, Chesapeake & Ohio; Safety, by J. V. Neubert, chief engineer maintenance of way, New York Central; Railway Problems of Today, by S. T. Bledsoe, president,

Atchison, Topeka & Santa Fe; and Truck Nosing, by H. A. Otis, mechanical engineer, Chicago Rapid Transit Company.

Maintenance Problems

RAILWAY Maintenance Problems, by Lt. Col. H. A. Hull, formerly district engineer, London & North Western and London Midland Scottish, Northampton, England, $5\frac{1}{2}$ in. by $8\frac{1}{2}$ in. 82 pages, illustrated. Bound in cloth. Published by the Railway Gazette, 33 Tothill street, Westminster S.W.1 London, England. Price 5 shillings, net.

The nature of this book is well described by the title; it comprises a compilation of practical problems encountered in the maintenance of roadway, tracks, bridges, buildings and other railway structures, together with an account of the manner in which the problems were solved. Most of the illustrations are drawn from the personal experience of the author, who explains at considerable length his reasons for the measures adopted. There is no pretext at covering the entire field of maintenance, but rather such phases of it as have been frequent sources of trouble and differences of opinion. Among the subjects covered are embankment slips, drainage, structure foundations, bridge substructures and superstructures, building defects, and a chapter on shovel tamping.

News of the Month

More Employees on Railroads in April

The Class I railroads of the United States, excluding switching and terminal companies, had a total of 1,049,543 employees on their payrolls as of the middle of April, according to reports compiled by the Interstate Commerce Commission. This number represents an increase of 26,850 employees, or 2.6 per cent, as compared with the middle of March, and an increase of 72,454 employees, or 7.4 per cent, as compared with the number in April, 1935.

Second Railroad Week Planned for July 13-18

Remembering the outstanding success which greeted the efforts of the railroads during the presentation of "railroad week" in the summer of 1935, the Western railroads have decided to observe the second annual railroad week during July 13-18. In announcing this decision H. G. Taylor, chairman of the Western Association of Railway Executives, said that at least 500 towns are expected to present programs this year, as compared with about 400 last year. "Nothing in railroad history," he continued, "so stimulated public interest in steam carriers or proved so helpful to the morale of railroad personnel." The celebrations this year, he said, will include "proclamations by governors and mayors, decorations of railroad property and business houses, unique publicity, hand-car derbies, train-calling contests, Red Cap races, rail walking contests, the blowing of locomotive whistles, visits to railroad shops and roundhouses, exhibits of both new and old railroad equipment, picnics and outings, gala street dances, popularity contests, colorful parades, and speeches before luncheon and civic clubs. These and many other forms of entertainment will constitute one of the most eventful weeks in western railroad history."

Employees' Compensation for Co-ordination Losses

Dismissal wages and other forms of compensation for railroad employees who may be displaced or otherwise affected by the consolidation of the facilities or services of two or more carriers acting jointly are provided for in an agreement which was recently consummated between representatives of the railway labor unions and the railroad managements. The agreement, which is for a period of five years beginning on June 18, 1936, does not apply to "rises and falls and

changes in volume or character of employment brought about solely by other causes," and does away with the necessity for the enactment of the Wheeler-Crosser bill, which would restrict reductions in railroad employment. The agreement provides (1) for reimbursement of employees who, as the result of consolidation, etc., are placed in positions paying less than they formerly received; (2) the payment of a "co-ordination allowance," to each employee deprived of employment, which shall be a monthly allowance equivalent in each instance to 60 per cent of the average monthly compensation of that employee for the twelve months prior to the co-ordination, the number of the monthly payments being based on the length of service as follows:

Length of Service	Period of Payment
1 yr. and less than 2 yrs.....	6 months
2 yrs. and less than 3 yrs.....	12 months
3 yrs. and less than 5 yrs.....	18 months
5 yrs. and less than 10 yrs.....	36 months
10 yrs. and less than 15 yrs.....	48 months
15 yrs. and over.....	60 months

and (3) the payment of a "separation allowance" in lieu of all other compensation to employees eligible to the benefits of the agreement, who elect to resign, the amount of the allowance being based on the length of service as follows:

Length of Service	Separation Allowance
1 yr. and less than 2 yrs.....	3 months' pay
2 yrs. and less than 3 yrs.....	6 months' pay
3 yrs. and less than 5 yrs.....	9 months' pay
5 yrs. and less than 10 yrs.....	12 months' pay
10 yrs. and less than 15 yrs.....	12 months' pay
15 yrs. and over.....	12 months' pay

The agreement also provides for the reimbursement for expenses and certain losses suffered by employees who, because of co-ordination, are required to change their places of residence.

Eight Railroads Receive Safety Contest Awards

Eight steam railroads and one zone of the Pullman Company were given plaques for winning first place honors in their respective groups in reducing employee casualties at the annual banquet of the Railroad Employees' National Safety Contest at Chicago on May 18. The winning railroads, together with the man-hours worked on each and the casualty rates per 1,000,000 man-hours, are given below:

Group A—50,000,000 or more man-hours, the Chicago, Milwaukee, St. Paul & Pacific, 67,333,000 man-hours, casualty rate, 3.45; Group B—20,000,000 to 50,000,000 man-hours, the Union Pacific, 41,480,000 man-hours, casualty rate, 2.51; Group

C—8,000,000 to 20,000,000 man-hours, the Oregon-Washington Railroad & Navigation Company, 1,276,000 man-hours, casualty rate 1.95; Group D—3,000,000 to 8,000,000 man-hours, Duluth, Missabe & Northern, 5,048,000 man-hours, casualty rate, 0.99; Group E—1,000,000 to 3,000,000 man-hours, Chicago & Illinois Midland, 2,024,000 man-hours, casualty rate, 1.48; and Group F—less than 1,000,000 man-hours, the Pittsburgh, Shawmut & Northern, 930,000 man-hours, casualty rate, 0.00. Switching and Terminal Railroads, Group A—1,500,000 or more man-hours, Union Railroad of Pittsburgh; and Group B—less than 1,500,000 man-hours, The Lake Terminal Railroad (Pittsburgh).

Eastern Store-Door Tariffs Again Suspended

In a further concession to trucking interests, the Interstate Commerce Commission has ordered a suspension of the modified pick-up and delivery service which the eastern railroads had planned to place in effect on May 25. Some time ago the commission voted to suspend for seven months tariffs which had been filed by the Eastern lines generally providing for free store-door pick-up and delivery service on I.c.l. freight which were scheduled to become effective on April 1, but later (on May 12) it issued a special permission order authorizing these lines to establish modified pick-up and delivery service by filing tariffs on not less than 10 days notice. Unlike the original tariffs, the modified tariffs made no provision for an allowance of five cents per 100 lb. to shippers or consignees who did the hauling themselves, this being a feature which was strenuously opposed by the truckers. In its most recent action the commission suspended the modified tariffs pending a complete investigation of store-door service in eastern territory.

Rail Net Slightly Lower in March

For March the Class I railroads of the United States had a net railway operating income of \$35,205,513, in March which was at the annual rate of return of 1.78 per cent on their property investment, as compared with a net of \$38,129,871, or 1.91 per cent, in the same month last year, according to reports compiled by the Bureau of Railway Economics of the Association of American Railroads. Operating revenues for March amounted to \$308,303,721, compared with \$280,890,307 in March, 1935, an increase of 9.8 per cent. Operating expenses totaled \$236,578,646, compared with \$212,724,302 in the same month of 1935, an increase of 11.2 per cent.

For the first three months of the year these lines had a net railway operating income of \$104,564,978, or a return of 2.11 per cent, as against a net of \$86,366,523, or 1.73 per cent, for the comparable period of 1935. Operating revenues for the three months totaled \$907,861,226, compared with \$800,017,238 for the same period last year, an increase of 13.5 per cent. Operating expenses totaled \$704,263,531 against \$624,719,489, an increase of 12.7 per cent.

Association News

Bridge and Building Association

The proceedings of the forty-second annual convention came from the printer late in May and Secretary Lichty is now distributing them to the members.

President T. H. Strate is planning a meeting of the executive committee in Chicago early in July to prepare plans for the convention next October. It is expected that the chairmen of the various committees will be invited to attend this meeting and to discuss their reports with the executive committee.

Railway Tie Association

Approximately 75 tie producers and railway officers interested in the purchase and use of railway cross ties attended the eighteenth annual convention of the Railway Tie Association at Cincinnati, Ohio, on May 20-21. At this meeting addresses were presented on Tie Renewal Trends by Dr. Julius H. Parmelee, director, and Graham E. Getty, assistant statistician, Bureau of Railway Economics (abstracted on a preceding page) and on the Place of Statistics in the Tie Industry, by Elmer T. Howson, editor, *Railway Engineering and Maintenance*. Other papers dealt more largely with problems peculiar to the production of crossties.

The following officers were elected: president, T. J. Turley, Jr., vice-president, Bond Brothers, Louisville, Ky; first vice-president, E. A. Morse, vice president, Potosi Tie & Lumber Co., St. Louis, Mo.; second vice-president, R. H. White, Jr., vice-president, Southern Wood Preserving Company, Atlanta, Ga.; members of executive committee, F. P. Dabolt, president, Tennessee Tie Company, Memphis, Tenn.; R. Van Metre, president, Wyoming Tie and Timber Company, Chicago; Meyer Levy, vice-president, T. J. Moss Tie Company, St. Louis, Mo.; E. J. Irving, vice-president, National Lumber and Creosoting Company, Texarkana, Tex.; H. R. Condon, vice-president, the Wood Preserving Corporation, Philadelphia, Pa.

American Railway Engineering Association

Twelve committees held meetings during May, including those on Water Service, Fire Protection and Sanitation, at Chicago, on May 5; Buildings, at Buffalo, N. Y., on May 5 and 6; Track, at Chicago on May 6; Iron and Steel Structures, at Cleveland, Ohio, on May 6 and 7; Waterways and Harbors, at Chicago, on May 7; Rail, at New York, on May 8; Masonry, at St. Louis, on May 14 and 15; Waterproofing of Railway Structures, at Cleveland, Ohio, on May 19; Maintenance of Way Work Equipment, at Chicago, on May 19; Economics of Railway Location, at Cleveland, Ohio, on May 22; Records and Accounts, at Pittsburgh, Pa.,

on May 28; and Economics of Railway Labor, at Chicago, on May 28, and at St. Paul, Minn., on May 29. The Board of Direction and the General Committee of the Engineering Division of the A.A.R. held a meeting in Chicago on May 20.

Three committees now have meetings scheduled for June as follows: Highways, at Chicago, on June 17; Wood Bridges and Trestles, at Madison, Wis., on June 26; and Water Service, Fire Protection and Sanitation, at New York, on June 30 and July 1.

The first of the summer bulletins will be ready for mailing about June 15. It will contain Professor H. F. Moore's report on the progress of the investigation to determine the cause of transverse fissures in rails; Doctor Talbot's discussion of the present status of the work of the Committee on Stresses in Track; and abstracts of the discussions of committee reports at the March convention.

Roadmasters Association

The proceedings of the fiftieth annual convention came from the printer early in May and have been distributed to the members.

Assistant Secretary C. A. Lichty is undertaking a campaign for new members. Twenty-three new members have already been enrolled since the last convention.

President Armstrong Chinn is planning to call a meeting of the executive committee in June to review the reports of committees and to formulate plans for the next convention.

I.C.C. Warns Motor Carrier Act Violators

Numerous complaints received by the I.C.C. that certain passenger and property carriers by motor vehicles are not collecting the rates, fares and charges lawfully on file and that tariffs and schedules are not being made available for public inspection have caused the commission to call the attention of the highway carriers to the provisions of the motor carrier act of 1935 on these points and to the penalties which it provides for violations. The commission has also reported that complaints have been made to the effect that "numerous carriers (highway) have published rates, fares, charges, or rules in tariffs issued in their name which duplicate or conflict with rates, fares, charges or rules issued for their account in tariffs of duly authorized agents. As above indicated, publication of such rates, etc., by both the carrier and its agent, is improper and must be discontinued."



Personal Mention

General

H. T. Livingston, division engineer on the Arkansas-Louisiana division of the Chicago, Rock Island & Pacific, with headquarters at Little Rock, Ark., has been promoted to trainmaster of the same division, with the same headquarters.

E. H. Piper, acting assistant superintendent of the Sheridan division of the Chicago, Burlington & Quincy, with headquarters at Sheridan, Wyo., and formerly district engineer maintenance of way on this road, has been promoted to assistant to the general manager, with headquarters at Chicago.

Charles G. Grove, superintendent of passenger transportation of the Eastern region of the Pennsylvania, with headquarters at Philadelphia, Pa., who was connected with the engineering department of this company for many years, has been appointed superintendent of the Williamsport division at Williamsport,



Charles G. Grove

Pa. Mr. Grove was born in York County, Pa., in December, 1890, and was graduated from Pennsylvania State college. He entered the service of the Pennsylvania in September, 1912, as a chairman in the chief engineer's department and in the following year was transferred to the maintenance of way department, serving as a rodman, assistant supervisor and supervisor on various operating divisions. In November, 1928, he was appointed division engineer of the St. Louis division at Terre Haute, Ind., and three years later he became division engineer of the Panhandle division at Pittsburgh, Pa. He was advanced to superintendent of the Wilkes-Barre division in July, 1933, and to superintendent of passenger transportation of the Eastern region in October, 1934.

William R. Triem, superintendent of the Monongahela division of the Pennsylvania, who was formerly connected with the engineering department of this

road, has been appointed general superintendent of telegraph at Philadelphia, Pa. He was born at Allegheny, Pa., on October 21, 1886, and was graduated from Ohio State University in 1910 with a degree in civil engineering. He entered the service of the Pennsylvania on June 5, 1910, as an assistant on the engineer corps, and on June 30, 1916, he was appointed assistant division engineer of the Akron division, later being transferred to the Logansport division. On March 1, 1924, he was promoted to assistant trainmaster and on March 10, 1927, he was promoted to trainmaster. He was appointed superintendent of the Buffalo division on February 15, 1928, and superintendent of freight transportation, Central region, on July 1, 1928. Mr. Triem became superintendent of the Monongahela division at Pittsburgh on September 16, 1933.

J. D. Farrington, general manager of the Ft. Worth & Denver City and the Wichita Valley, and formerly a roadmaster on the Chicago, Burlington & Quincy, has been appointed chief operating officer of the Chicago, Rock Island & Pacific, with headquarters at Chicago. He was born on January 27, 1891, at St. Paul, Minn., and entered railway service with the Great Northern in June, 1909, in the engineering department. In 1910 he went with the Chicago, Burlington & Quincy as a timekeeper, then serving successively as assistant foreman, foreman and roadmaster in the track department. Later he was transferred to the operating department, where he served successively as assistant trainmaster, trainmaster and assistant superintendent. From 1917 to 1919, Mr. Farrington served with the United States Army as lieutenant, captain



J. D. Farrington

and major. Following the war he returned to railroad service as superintendent of the Quincy, Omaha & Kansas City (part of the Burlington), being appointed superintendent of the St. Joseph division of the Burlington on December 1, 1922. In the following year he was transferred to the Aurora division and on January 1, 1930, he was advanced to general superintendent of the Missouri district, being transferred to Burlington, Iowa, on May 1, 1931. Since October 1, 1931, Mr. Farrington has been general manager of

the Ft. Worth & Denver City and the Wichita Valley, with headquarters at Ft. Worth, Texas.

Collins W. Van Nort, superintendent of freight transportation of the Central Region of the Pennsylvania, with headquarters at Pittsburgh, Pa., and an engineer by training and experience, has been appointed superintendent of the Wilkes-Barre division at Sunbury, Pa. Mr. Van Nort was born at Scranton, Pa., on April 2, 1891, and was graduated from Lehigh University in 1913. He entered the service of the Pennsylvania on June 15, 1913, as a rodman on the Monongahela division, later serving as a transitman. On September 28, 1917, he became assistant supervisor on the Buffalo division, later serving in the same capacity on the New York division, and was promoted to supervisor of the Pittsburgh division on January 18, 1927. Mr. Van Nort was appointed division engineer of the Erie and Ashtabula division on November 12, 1928, being transferred to the Pittsburgh division on December 22, 1930. On July 1,



Collins W. Van Nort

1933, he was appointed superintendent of the Erie and Ashtabula division and on June 15, 1934, he became superintendent of freight transportation of the Central region.

J. S. Gillum, division engineer of the Pittsburgh division of the Pennsylvania, has been promoted to superintendent of the Monongahela division, with headquarters at Pittsburgh, Pa. Mr. Gillum was born at Terre Haute, Ind., on February 12, 1893. He entered the service of the Pennsylvania as an assistant on the engineering corps of the St. Louis division on November 8, 1915. On January 16, 1923, he was transferred to the Columbus division and on December 6, 1926, to the Middle division. On April 28, 1927, he was promoted to assistant supervisor on the Philadelphia Terminal division and on July 1, 1928, he was appointed supervisor of the Trenton division, being transferred to the Philadelphia division on November 10, 1929. Mr. Gillum was promoted to assistant division engineer of the Philadelphia Terminal division on March 16, 1930, and on June 1, 1931, he became division engineer of the Erie & Ashtabula division, being transferred to

the Ft. Wayne division on July 1, 1933, and to the Pittsburgh division on October 5, 1934, where he remained until his recent appointment as superintendent of the Monongahela division.

Louis C. Fritch, operating officer of the Chicago, Rock Island & Pacific, and formerly chief engineer of the Chicago Great Western, has retired, effective May 15. A native of Springfield, Ill., Mr. Fritch was



Louis C. Fritch

born in 1869. He received his higher education at the University of Cincinnati, where he graduated with degrees in civil engineering and in law. Mr. Fritch entered railway service in 1884 with the Ohio & Mississippi (now part of the Baltimore & Ohio) as supervisor's assistant. On November 1, 1893, he was appointed division engineer of the Baltimore & Ohio Southwestern (now part of the B. & O.), which had absorbed the Ohio & Mississippi, and in September, 1899, he became superintendent of the Mississippi division. Mr. Fritch went with the Illinois Central in 1903 as assistant to the general manager, being appointed assistant to the president in 1906 and consulting engineer in 1909. In November of the latter year he left the Illinois Central to go with the Chicago Great Western as chief engineer, remaining in that capacity until 1914, when he went with the Canadian Northern (now part of the Canadian National) as assistant to the president. In August, 1915, he was made general manager of the lines east of Port Arthur, Ont., holding this position until the spring of 1917, when he accepted a position with the Seaboard Air Line as general manager. In June, 1918, Mr. Fritch severed his connection with the Seaboard Air Line and shortly thereafter became connected with the Rock Island as vice-president of corporate matters. In 1920 he was made vice-president of construction and maintenance and in 1922 he was further advanced to vice-president in charge of operations. In 1933, when trustees were appointed for the Rock Island, Mr. Fritch's title was changed to operating officer. Mr. Fritch was one of the founders of the American Railway Engineering Association and served as its first secretary (1900-06). He is also a past-president of the A.R.E.A. (1910-11) and is an honorary member of this association.

H. C. Murphy, superintendent of safety of the Chicago, Burlington & Quincy, and formerly engineer maintenance of way on this road at Lincoln, Neb., has been appointed assistant to the executive vice-president, with headquarters as before at Chicago. Mr. Murphy was born on August 27, 1892, at Canton, Ill., and received his higher education at Iowa State College, Ames, Iowa, and at the Armour Institute of Technology, Chicago. His first railway service was with the Minneapolis & St. Louis; during the early years of his career he also engaged in municipal and highway engineering work in Iowa. He entered the service of the Burlington on July 13, 1914, as a clerk in the auditor's office at Chicago, later entering the engineering department



H. C. Murphy

as a rodman at La Crosse, Wis. During the winter of 1915-16 he continued his studies at Ames, then returning to the Burlington as an instrumentman at Chicago. During the war he served as a pilot in the United States Army Air Service, returning to the Burlington in 1919 as an assistant engineer at Centralia, later holding the positions of acting division engineer at Centralia, division engineer at Kansas City, Mo., and division engineer and roadmaster at the latter point. In August, 1923, Mr. Murphy was appointed assistant engineer maintenance of way at Alliance, Neb., and in April of the following year he was appointed district engineer maintenance of way at Galesburg, Ill. In February, 1925, he was sent to Lincoln, Neb., as engineer maintenance of way and after two years in this position he was appointed transportation assistant to the general manager, Lines West, at Omaha, Neb., being transferred to Chicago in October, 1928. In April, 1929, Mr. Murphy was appointed superintendent and served in this capacity and as assistant superintendent at various points until August, 1933, when he was appointed superintendent of safety, with headquarters at Chicago.

Engineering

F. P. Funda, roadmaster on the Chicago, Rock Island & Pacific at Brinkley, Ark., has been promoted to division engineer of the Arkansas-Louisiana division, with headquarters at Little Rock,

Ark., where he replaces **H. T. Livingston**, who has been appointed trainmaster as announced elsewhere in these columns. These appointments were effective on May 16.

V. H. Carruthers has been appointed acting division engineer on the Canadian Pacific, with headquarters at Saskatoon, Sask., to succeed **D. C. Chisholm**, who has been granted a leave of absence.

L. E. Gingerich, assistant division engineer of the New York division of the Pennsylvania, has been promoted to division engineer of the St. Louis division, with headquarters at Terre Haute, Ind., succeeding **C. O. Long**, who has been transferred to the Fort Wayne division, with headquarters at Fort Wayne, Ind. Mr. Long replaces **H. H. Pevler**, who has been transferred to the Pittsburgh division, with headquarters at Pittsburgh, Pa., to succeed **J. S. Gillum**, whose appointment as superintendent is noted elsewhere in these columns.

Alfred E. Perlman, assistant engineer maintenance of way of the Chicago, Burlington & Quincy, with headquarters at Chicago, has been appointed to the newly-created position of engineer maintenance of way of the Denver & Rio Grande Western, with headquarters at Denver Colo., effective May 1. A biographical sketch and a photograph of Mr. Perlman were presented in the August, 1935, issue of *Railway Engineering and Maintenance*, on the occasion of his appointment as assistant engineer maintenance of way of the Burlington.

G. R. Haworth, whose appointment as engineer maintenance of way of the Western Maryland at Baltimore, Md., was noted in the May issue, was born on June 25, 1888, at Philipsburg, Pa. He entered railway service in June, 1905, and, after brief service on two small roads he went with the Erie in 1907. Later in the same year he left railroad employ and was associated successively with W. H. Woodcock & Company and the Atlantic, Gulf & Pacific Dredging Company. Returning to the Erie in 1908 he remained until the following year, when he was for a short time employed by the DeGeorono Construction Company, Pittsburgh, Pa., before becoming associated with the Chicago, Burlington & Quincy. During 1910 he served with the Colorado & Southern and in government service. In 1911 he became affiliated with the Western Maryland, where he has since remained, being division engineer at Cumberland, Md., at the time of his recent appointment as engineer maintenance of way with headquarters at Baltimore.

Track

A. Tronrod has been appointed roadmaster on the Canadian Pacific at Nipawin, Sask., to succeed **N. A. Link**, who has been transferred to Wilkie, Sask., to replace **A. Swanson**, who has been transferred to the Regina division.

A. J. Wright, assistant roadmaster on the McCook division of the Chicago, Burlington & Quincy, has been promoted to roadmaster, with headquarters at Cur-

tis, Neb., to succeed **W. E. Waygood**, who has been assigned to other duties.

M. Carroll, assistant roadmaster on the Chicago & North Western, with headquarters at Milwaukee, Wis., has been promoted to roadmaster of the Second sub-division of the Wisconsin division, with headquarters at Harvard, Ill., succeeding **D. J. Hovland**, who has resigned.

J. Fraser, assistant roadmaster on the Canadian National at Trenton, Ont., has been promoted to roadmaster on the Belleville division at Belleville, Ont., to succeed **J. R. Cassidy**, who has retired. The position of assistant roadmaster at Trenton has been abolished and the headquarters of **F. B. Giffin**, roadmaster at Brockville, Ont., has had his headquarters moved to Belleville.

T. B. Fulkerson, track supervisor on the Cincinnati division of the Pennsylvania, with headquarters at Anderson, Ind., has been transferred to the Cincinnati division at Richmond, Ind., succeeding **I. W. Puterbaugh**, who has been transferred to the Indianapolis division at Spencer, Ind. Mr. Puterbaugh replaces **L. F. Beard**, who has been transferred to Anderson, Ind., to succeed Mr. Fulkerson.

B. Bristow, an assistant engineer on the Chicago, Rock Island & Pacific, has been appointed acting roadmaster, with headquarters at El Dorado, Ark., succeeding **John E. Crawford**, who has been transferred to Brinkley, Ark., where he replaces **F. P. Funda**, whose appointment as division engineer is noted elsewhere in these columns.

D. W. Bickett, a track inspector on the Nebraska-Colorado division, has been appointed roadmaster on the Iowa-Minnesota division, with headquarters at Manly, Iowa, to succeed **C. H. Gaylord**, whose promotion to master carpenter is noted elsewhere in these columns.

Roy A. Brown, whose appointment as roadmaster on the Chicago, Rock Island & Pacific at Cedar Rapids, Iowa, was announced in the May issue, was born on February 15, 1902, at Rockford, Mich. Graduating from the University of Michigan in 1924, Mr. Brown entered the service of the Rock Island on July 1 of that year as a rodman in the engineering department. On March 1, 1926, he was advanced to instrumentman at Trenton, Mo., and on October 1 of the following year he was appointed resident engineer, serving in this capacity on the construction of new lines and grade revisions on the Missouri and Illinois divisions. On May 1, 1930, Mr. Brown was advanced to division engineer at Cedar Rapids, Iowa, and on September 15 of the same year he was appointed roadmaster at Goodland, Kan. From December 1, 1930, to August, 1931, he served as an instrumentman at Fairbury, Neb., and Trenton, and from the latter date until the time of his recent appointment he served as a track inspector at various points.

Floyd A. Williams, whose appointment as roadmaster on the Chicago, Rock Island & Pacific at Trenton, Mo., was noted in the May issue, was born on August 22, 1895, at Tipton, Iowa. He entered rail-

way service on June 1, 1912, as a section laborer on the Rock Island. From October 8, 1914, to July 1, 1915, he served as an assistant yard foreman, then being promoted to section foreman. On January 5, 1917, he was appointed an assistant extra gang foreman, which position he held until May 22, 1917, when he entered the United States Army. On June 15, 1919, Mr. Williams returned to the service of the Rock Island, serving as a yard and extra gang foreman until May 7, 1929, when he was advanced to roadmaster. On December 20 of the same year he was reappointed a yard foreman and on November 1, 1931, he was made a track inspector, which position he held until his recent appointment as roadmaster.

Bridge and Building

H. W. Froats has been appointed bridge and building master on the Canadian Nation at Stratford, Ont., to succeed **W. D. Graham**, who has been transferred to London, Ont., to replace **G. C. McCue**, who has retired.

C. H. Gaylord, roadmaster on the Iowa-Minnesota division of the Chicago, Rock Island & Pacific, with headquarters at Manly, Iowa, effective May 1, was appointed master carpenter of the same division, with headquarters at Des Moines, Iowa.

E. M. Roberts, assistant bridge and building supervisor on the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Mt. Carmel, Ill., has been promoted to supervisor of bridges and buildings with the same headquarters, to succeed **J. A. Hanson**, whose death is noted elsewhere in these columns.

S. B. Jones, foreman carpenter on the Michigan Central, with headquarters at Jackson, Mich., has been appointed division foreman of buildings, with the same headquarters, to succeed **J. L. Harden**, who has been transferred to Detroit, Mich., to succeed **Charles F. Green**, whose death is noted elsewhere in these columns.

Paul Mouhot, a bridge and building foreman on the Southern Pacific Lines in Texas and Louisiana, has been appointed assistant bridge and building supervisor of the Houston division, with headquarters at Houston, Tex. **R. B. Melton**, office engineer at Ennis, Tex., has been appointed assistant bridge and building supervisor of the San Antonio division, with headquarters at San Antonio, Tex., and **A. P. Reese** has been appointed assistant bridge and building supervisor of the Dallas division.

J. G. Woodall, whose appointment as bridge and building supervisor on the Southern at Lexington, Ky., was announced in the May issue, was born on September 2, 1894, at Scottsboro, Ala. He graduated from Alabama Polytechnic Institute with a degree in civil engineering in 1916, and entered the service of the Southern on September 1 of the same year as a rodman. In the following year he was appointed an inspector, and in 1919 he left the railroad to become superintendent of bridges of Etowah County, Ala. In 1921 he was ap-

pointed office engineer at Birmingham, Ala., for Dwight P. Robinson, and in 1923 he returned to railway service as an inspector on the Cincinnati, New Orleans & Texas Pacific (part of the Southern system), being appointed assistant track supervisor on the Southern in the following year. In 1926 he was advanced to track supervisor on the C.N.O. & T.P.,

Obituary

Charles F. Green, division foreman of buildings on the Michigan Central, with headquarters at Detroit, Mich., died on March 2.

J. A. Hanson, bridge and building supervisor on the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Mt. Carmel, Ill., died on April 5.

W. C. Loree, who formerly served as engineer maintenance of way on various divisions of the Pennsylvania, died on May 6 at New York, at the age of 76 years. At the time of his retirement in 1914, Mr. Loree was serving as general manager of the Cincinnati, Hamilton & Dayton and of the Baltimore & Ohio Southwestern (both now parts of the Baltimore & Ohio).

Shelby S. Roberts, chief of the section of securities, Bureau of Finance, Interstate Commerce Commission, and a railway civil engineer of wide experience, died on May 6 at Washington, D. C., after a brief illness. Mr. Roberts was born on April 13, 1874, at Louisville, Ky., and received his engineering education at Rose Polytechnic Institute, Terre Haute, Ind. He also attended John Marshall Law School, Chicago, and the Washington College of Law, Washington, D. C., obtaining the degree of LL.B. in 1925. Mr. Roberts entered railway service in the summer of 1898 as a track apprentice on the Illinois Central. In the following year he left this company to go with the Louisville & Nashville, where he served successively as an instrumentman and building inspector, engineer in charge of various improvements, engineer in charge of maintenance of way on various divisions, and roadmaster. In 1905 he severed his connection with the L. & N., to become superintendent of building construction for F. C. Brent at Pensacola, Fla. In the following year he returned to the Illinois Central, serving as assistant engineer and office engineer in the construction department until 1908, when he went to the University of Illinois as professor of railway civil engineering. In 1911 he was appointed division engineer of construction on the Illinois Central, in which capacity he had charge of a number of large construction and improvement projects. From 1913 to 1918, Mr. Roberts engaged in the private practice of general and railway civil engineering at Chicago, then being appointed staff officer of engineering and senior assistant engineer with the United States Railroad administration, Southern region. In 1920 he was appointed assistant director, bureau of finance, Interstate Commerce Commission, in which capacity he was in charge of forces handling engineering matters that came before that bureau. His appointment as chief of the section of securities of the commission came in 1935.

Supply Trade News

General

The New York district sales office of the **Republic Steel Corporation** has opened a new sub office in the State Bank building, Albany, N. Y., with **J. M. Higginbotham** in charge.

A conference on welding, which is to be sponsored by a group of manufacturers in that field, is to be held at 2211 West Pershing road, Chicago, on June 4-6. This meeting, to be known as the Midwest Welding Conference, will be open to all persons interested in welding. The program will include the reading of papers on various types of welding by authorities in the various fields, demonstrations of a variety of operations in various types of welding and exhibits of products of welding materials and equipment.

The Truscon Steel Company, Youngstown, Ohio, has made arrangements to finance the purchase of Truscon buildings on a long-term basis through the Equipment Acceptance Corporation, a unit of Commercial Investment Trust, in accordance with the regulations established by the Federal Housing Administration. Under this arrangement purchasers of Truscon buildings may obtain long-term financing where the amount of the loan required is not less than \$2,000 nor more than \$50,000. If the buyer has plants in more than one location the same offer applies to each of them. The loan must be for a period of not less than 6 months nor more than 60 months and must be payable in equal monthly installments. It must be for the purpose of repair, alteration or improvements of real property already improved by, or to be converted into, commercial buildings, manufacturing or industrial plants.

Personal

R. M. Hamilton, whose appointment as vice-president of the **T. J. Moass Tie Company**, St. Louis, Mo., was noted in the May issue, graduated from Westminster College at Fulton, Mo., in 1912. After several years' experience in the steel industry, and two years in the army as first lieutenant of artillery during the war he entered the employ of the T. J. Moass Tie Company in 1920. He served in various capacities until 1930 when he resigned to become vice-president of D. B. Framp-ton & Company, Pittsburgh, which position he has held until he resigned to become a vice-president of the T. J. Moass Tie Company.

Frank B. Powers has been appointed manager of the Railway Engineering department of the **Westinghouse Electric & Manufacturing Company**, to fill the vacancy caused by the recent death of **Claude Bethel**. Mr. Powers was born at Chicago, and following his graduation with the degree of B. S. in E. E. from the University of Illinois, he joined the

(Continued on page 384)

What Rail Anchor Has Greatest Holding Power?

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Westinghouse Electric & Manufacturing Company, attending both the engineering and the design schools as part of the company's graduate student course. After this training he helped service the 6,000



Frank B. Powers

hp. Virginian Railway locomotives. On his return to Westinghouse at East Pittsburgh, Mr. Powers entered the heavy traction section of the Railway Engineering department, specializing on the design of motors for the Pennsylvania Railroad locomotives. In January, 1935, he was promoted to section engineer of all d.c. traction motors, which position he held until this new appointment.

Charles L. Strobel, Sr., formerly a prominent consulting engineer and railroad contractor, who died on April 4 as noted in the May issue was born at Cincinnati, Ohio, on October 6, 1852, and received his higher education in civil engineering at the Royal Institute of Technology at Stuttgart, Germany. He first entered railway service as a draftsman at Cincinnati, Ohio, in 1873, being appointed assistant engineer on the Cincinnati Southern (now part of the Southern) in the following year. In 1878, Mr. Strobel became connected with the Keystone Bridge Company (a subsidiary of Carnegie, Phipps & Co., Ltd., which later became the Carnegie Steel Company), serving as assistant to president and engineer at Pittsburgh, Pa., until 1885, when he was sent to Chicago as consulting engineer and agent, being appointed also consulting engineer of Carnegie, Phipps & Co., Ltd., in the following year. It was during his connection with these firms that Mr. Strobel designed the first standard sections for steel I-beams and channels and introduced Z-bars and Z-bar columns. He was also intimately connected with the construction of many large bridges and office buildings. In 1893 Mr. Strobel entered private practice as a contracting engineer, incorporating his business in 1905 under the name of the Strobel Steel Construction Company, which he served as president until 1922, when he was made chairman of the board. In 1926 he severed his connection with the firm and retired.

Joseph L. Block, vice-president of the Inland Steel Company, Chicago, has been elected executive vice-president in charge

of sales, and **Albert C. Roeth**, vice-president, has been elected vice-president and general manager of sales. These appointments were made coincident with the resignation of **Charles R. Robinson**, first vice-president and general manager of sales and a director of the company.

Mr. Block has been associated with the Inland Steel Company since 1922. He has been a vice-president since 1929 and a director since 1930. For a number of years he has been in charge of the sale of bars and semi-finished steel, and has also directed the company's advertising activities.

Mr. Roeth has been associated with Inland since 1911, and has been a vice-president of the company since 1929. He has been in charge of the sale of structural shapes, plates and sheet piling.

Mr. Robinson started his business career in 1890 as a salesman of tool steel

and in 1910 was transferred to New York as general manager of sales. In the following year his headquarters were transferred to Buffalo, N. Y. He held the



Charles R. Robinson

latter position until 1918, when he was elected vice-president in charge of sales. In January, 1922, he returned to the Inland Steel Company, coincident with that company's entrance into the rolling of standard section heavy T-rails, becoming vice-president in charge of railroad sales. In August, 1935, he was elected first vice-president and general manager of sales, which position he has held until his resignation.

Trade Publications

Facts About Built-Up Roofs—Johns-Manville, New York, has recently published a 22-page illustrated brochure, in which are discussed the economies, serviceability and installation of built-up roofs. The brochure contains many photographs showing examples of built-up roofs and their application, as well as drawings illustrating the proper methods of applying built-up roofs and the flashing for such roofs.

Bethanized Wire—A four-page folder featuring Bethanized zinc-coated wire, its general adaptability, its manufacture and the grades in which it can be furnished to meet special conditions, has been issued by the Bethlehem Steel Company, Bethlehem, Pa. The folder also includes tabulated information on the minimum weight of coating furnished on wire of different sizes, and on extras for wire of special grade or coating.

Pneumatic Tools—An informative, well-illustrated, 16-page catalogue dealing with pneumatic tools for bridge and building work has been issued by the Ingersoll-Rand Company. This catalogue, No. 2219, features the new Pott Impact wrench of the company, but also describes and illustrates the company's Crawl-Air compressors and railroad-mounted units, as well as the wide variety of pneumatic tools manufactured and distributed by the company for simplifying and cutting the cost of bridge and building construction and repair operations.



Joseph L. Block

for Park Brothers & Co. In 1900, he entered business for himself, handling various steel products on a brokerage basis. In 1904, he entered the employ of the Inland Steel Company as a salesman, be-



Albert C. Roeth

coming assistant general manager of sales in 1906. In October, 1908, he resigned from the Inland Steel Company to become district sales manager for the Lackawanna Steel Company at Chicago,



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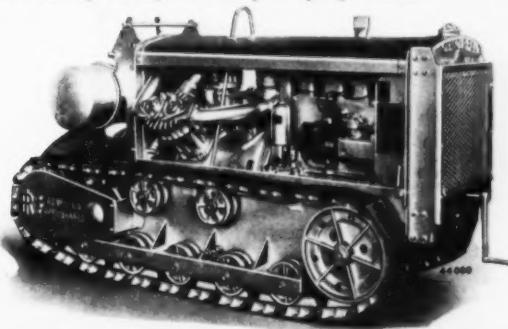
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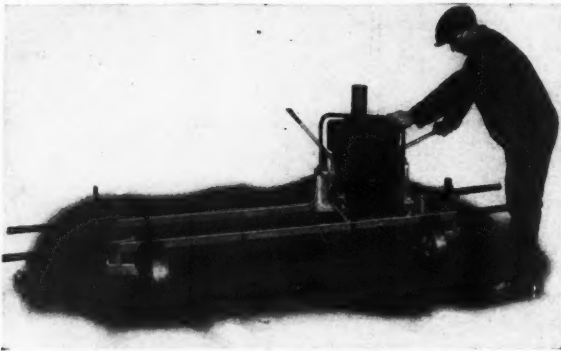
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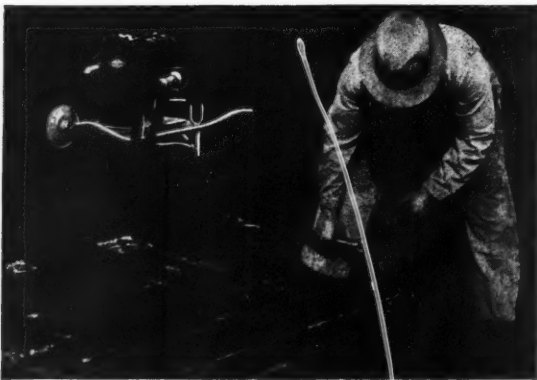
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Thunderous applause greeted the last statement. Flea, bedbug and louse joined legs and danced joyously with anticipated delight. Cries of "We'll start from SCRATCH!" . . . "Each for all and all for ITCH!" . . . "We'll DESTROY EFFICIENCY!" . . . filled the air. "Body and clothes for the flea and louse," cried the bedbugs, "and we'll take care of the REST." "We'll CRAWL along with the SUCKERS," added the fleas and lice.

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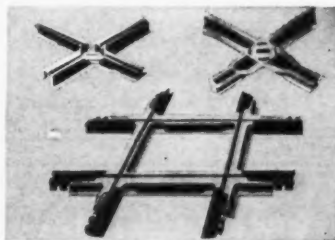
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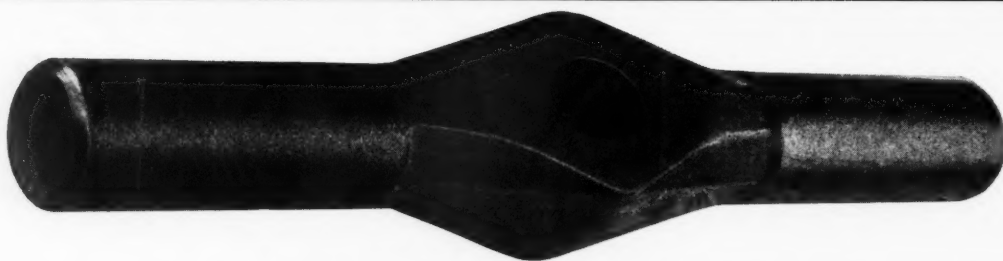
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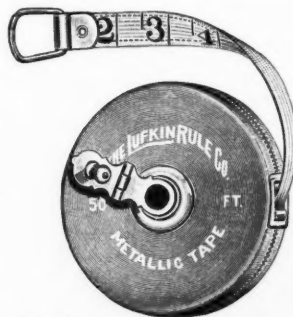
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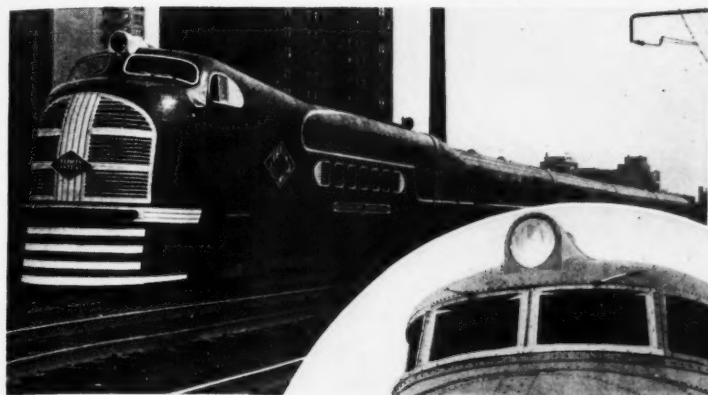
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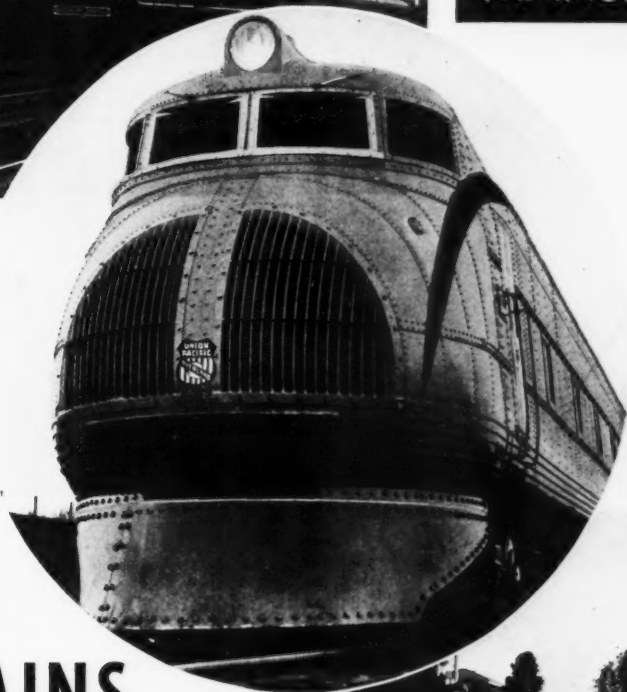
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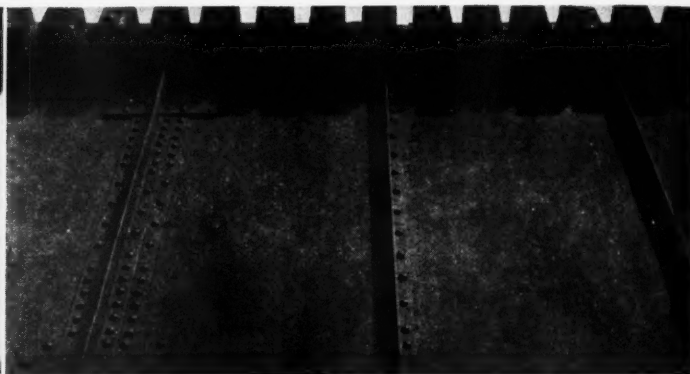
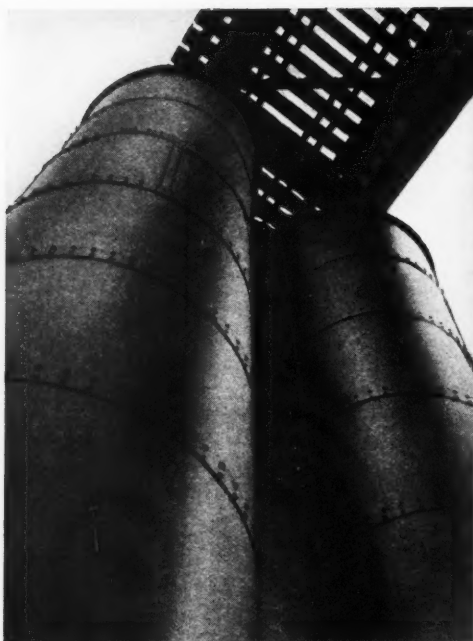
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ALPHABETICAL INDEX TO ADVERTISERS

A	
Air Reduction Sales Co.....	337
Armco Culvert Mfrs. Assn.....	346
B	
Barco Manufacturing Company.....	345
Bethlehem Steel Co.....	334-335
C	
Calcyanide Company.....	387
Carnegie-Illinois Steel Corp.....	339
Columbia Steel Co.....	339
D	
Dearborn Chemical Company.....	390
E	
Eaton Manufacturing Co.....	330
F	
Fairbanks, Morse & Co.....	336
Fairmont Railway Motors, Inc.....	333
I	
Ingersoll-Rand Co.....	385
Ingot Iron Railway Products Co.....	346
L	
Lufkin Rule Co., The.....	388
Lundie Engineering Corporation, The.....	331
M	
Maintenance Equipment Co.....	329
Master Builders Co., The.....	342
Metal & Thermit Corporation.....	392
Morrison Metalweld Process Inc.....	338
Morrison Railway Supply Corp.....	338

N	
National Lead Company.....	391
Nordberg Mfg. Co.....	332
O	
Oxweld Railroad Service Company, The.....	341
P	
Permutit Co., The.....	387
Portland Cement Association.....	340
R	
Railway Track-Work Co.....	386
Ramapo Ajax Corporation.....	348
S	
Sika, Inc.....	388
Simmons-Boardman Pub. Co.....	386-388-389
T	
Taylor-Wharton Iron and Steel Co.....	387
Truscon Steel Company.....	343
U	
United States Steel Corporation	
Subsidiaries.....	339
United States Steel Products Co.....	339
Union Carbide and Carbon Corp.....	341
W	
Warren Tool Corp.....	388
Woodings Forge and Tool Co.....	383
Woodings-Verona Tool Works.....	383

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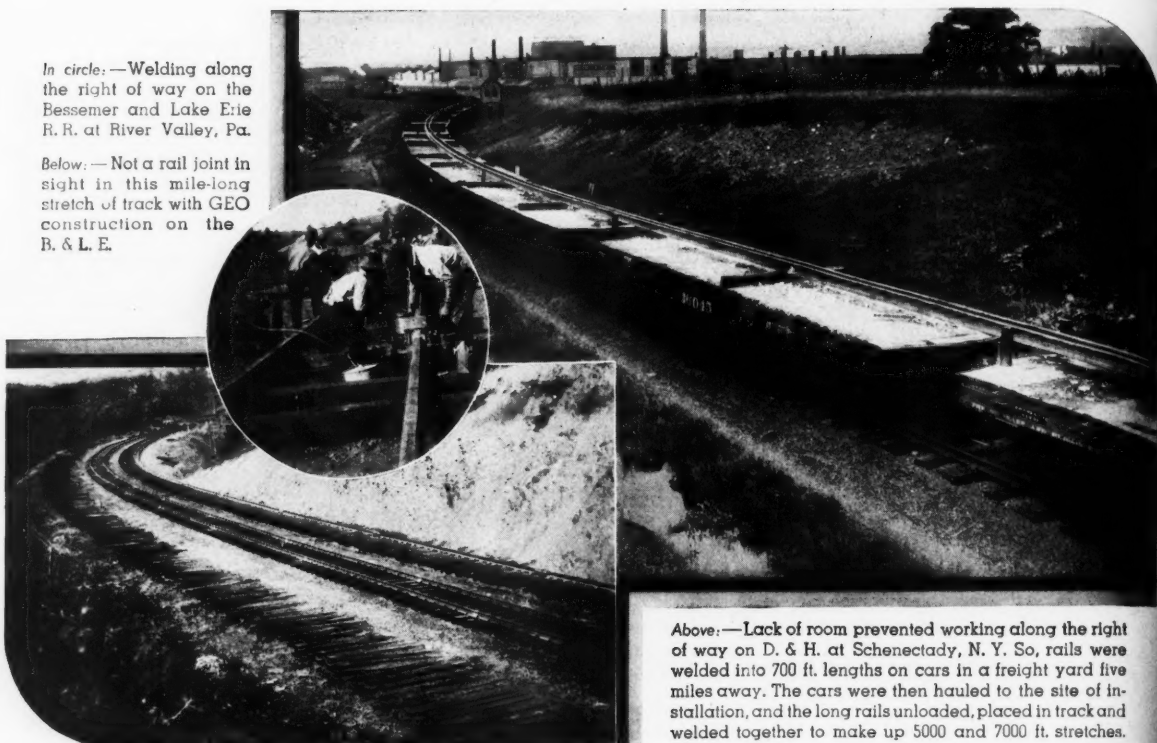
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Soon you'll think of **RAIL LENGTHS** **IN TERMS OF MILES**

In circle:—Welding along the right of way on the Bessemer and Lake Erie R. R. at River Valley, Pa.

Below:—Not a rail joint in sight in this mile-long stretch of track with GEO construction on the B. & L. E.



Above:—Lack of room prevented working along the right of way on D. & H. at Schenectady, N. Y. So, rails were welded into 700 ft. lengths on cars in a freight yard five miles away. The cars were then hauled to the site of installation, and the long rails unloaded, placed in track and welded together to make up 5000 and 7000 ft. stretches.

Not many years ago the advisability of increasing the standard length of rails from 33 to 39 ft. was a topic for considerable discussion. Now it seems safe to predict that rail lengths will soon be thought of in terms of miles instead of feet.

Continuous rails provide a long-sought solution to the track maintenance problem. Rails welded together into long stretches have no gaps for wheels to pound; no rail ends to batter. Joints are eliminated and joint maintenance is banished. Frequent track lining and surfacing become unnecessary. Rail life is increased; wear and tear on rolling stock and motive power reduced.

Nor, is there any doubt about continuous rails

behaving satisfactorily under all sorts of conditions. A number of jointless stretches, varying from half a mile to one and a third miles in length, are now in service on main line track. Some are on straightaways, some on curves, some level and some on grades. Several installations have been giving good service for two and a half years. On the Delaware & Hudson, welded rails have been installed with M. & L. construction; on the Bessemer & Lake Erie, with GEO; and, elsewhere, with ordinary double-shoulder tie plates.

It will pay you to investigate. Write now for information, or, ask to have our nearest representative call and give you the complete story.

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